T73-10658

EPS-521

CR-128701
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TEST REPORTS
ELECTRON-PROTON SPECTROMETER
ENGINEERING TEST UNIT

LEC Document Number EPS-521

N73-26451

(NASA-CR-128701) TEST REPORT: ELECTRON-PROTON SPECTROMETER ENGINEERING TEST UNIT (Lockheed Electronics Co.) 69 p HC $5.50 CSCL 14B G3/14 Unclas 62848

Prepared by

Lockheed Electronics Company, Inc.
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Houston, Texas

Under Contract NAS 9-11373

For

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas
January 1972

TEST REPORTS
ELECTRON-PROTON SPECTROMETER
ENGINEERING TEST UNIT

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PREFACE

This test report is comprised of three separate reports each covering a distinct phase of testing of the Engineering Test Unit as follows:

Thermal/Vacuum Test
Vibration Test
Shock Test

TEST REPORT: ELECTRON-PROTON SPECTROMETER ENGINEERING TEST UNIT, THERMAL/VACUUM TEST

TEST REPORT: ELECTRON-PROTON SPECTROMETER
ENGINEERING TEST UNIT, THERMAL/VACUUM TESTING

INTRODUCTION

The Engineering Test Unit of the Electron-Proton Spectrometer (EPS) was taken to Building 33, Ultra-High Vacuum Space Chamber Facility, NASA/MSC for thermal/vacuum testing over the period 27 September - 1 October 1971 inclusive as called for in LEC document EPS-435, Verification Plan for Electron-Proton Spectrometer, Appendix B.

PURPOSE

The purpose of the test was to confirm the thermal analysis, verify that the thermal design would control the temperatures of the instrument within the required limits and show that the electronics package would operate satisfactorily when subjected to the thermal environment.

DESCRIPTION

The EPS Engineering Test Unit reflects a design change from the Thermal Test Unit previously tested. It has been modified to provide vibration isolation of the electronics, which necessitated some changes to the thermal design. This revised design is shown diagramatically in Figure 1.

The Engineering Test Unit reflects the proposed 'flight' design in all respects. Temperature data for the electronics package and detectors was provided by the temperature monitors that are part of the EPS electronics, and read out from the Bench Test Equipment (BTE) display.

TEST DESCRIPTION

The EPS Engineering Test Unit and the BTE were taken to Building 33, NASA/MSC on the 26 September 1971, to be subjected to the thermal/vacuum test conditions. The same test fixture that had been used for the Thermal Test Unit was used for the Engineering Test Unit (for a description of the test fixture, see LEC EPS-518, Electron-Proton Spectrometer Thermal Test Unit, Thermal/Vacuum Test Report).

The Engineering Test Unit was mounted to the test fixture, installed in chamber 'N', the chamber door closed and pump down started. Testing started at 0300, 27 September 1971. The instrument was subjected to the test cases shown in Figure 2, and data was monitored via the BTE and recorded. Test cases were not run in the sequence specified in Figure 2. They were run in the sequence shown by Figures 3 through 9. This continued until all of the test cases had been run.

After running test case 6, a decision was made to drop test case 7 and re-run test case 6 without the 'O-ring' seal under the flange.

TEST RESULTS

Figures 3 through 9 show time/temperature curves of the detector and electronic package, together with the power profile, for each of the test cases run. Appendix A gives the log sheets for the complete test series. Figure 10 shows the temperature limits placed on the Engineering Test Unit and Figure 11 shows the temperatures reached during test together with the worst case temperature predicted by the thermal analysis for each test case.

Comparison of the test temperatures with the required temperature limits show that, with the exception of the first run of case 6, they are satisfactory. Test case 6 was marginal on the detector temperature; re-running this case showed that the 'O'ring' seal had had excessive squeeze on it, creating an excessive heat-leak between the high skin temperature of the fixture and the mounting flange. Also, the vibration isolators are not as great a heat barrier as had been hoped for. However, the rerun of case 6 was within the required limits, although greater than the predicted temperatures.

Appendix B summarizes the Power System Performance during the test runs. Appendix C shows results of the functional tests conducted at the end of each test case.

CONCLUSIONS

Generally, the test confirmed the analytical approach of the thermal analysis and verified that the thermal design will control the temperatures of the instrument within the required limits. The functional tests showed that the instrument will function properly when subjected to the thermal/vacuum environment.

The conditions during test case 6 are based on a worst case situation, the skin and cavity temperatures of the test fixture being the worst case values provided by NAR/Downey and the heat flux input being the worst case situation that could be justified. It is not anticipated that all these parameters would combine under actual conditions. Hence, test case 6 is considered adequate.

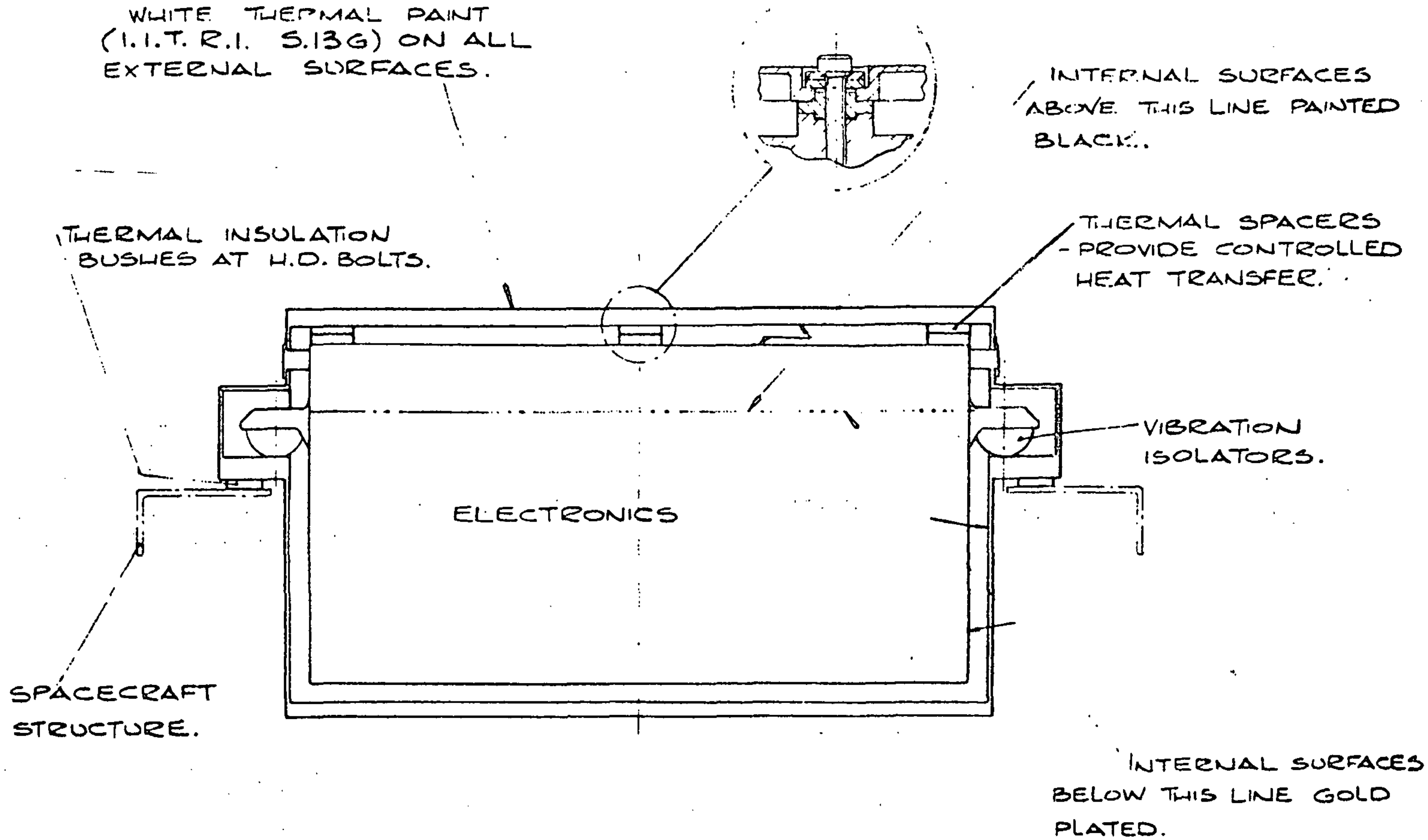
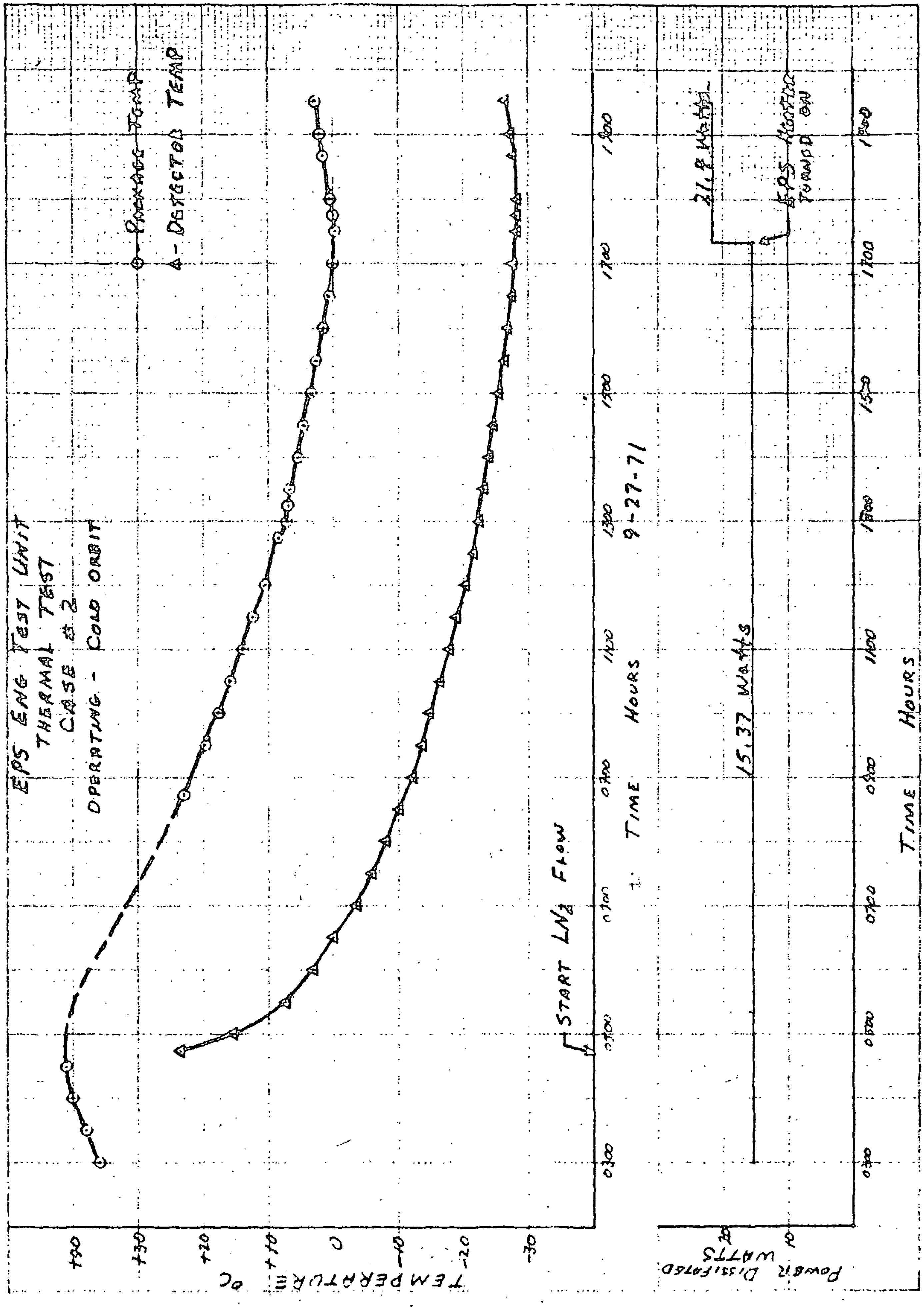


Figure 1 THERMAL CONTROL DIAGRAM

TEST CASE	INSTRUMENT MODE	POWER	SIMULATED β ANGLE	HOT OR COLD	ABSORBED HEAT FLUX (BTU/HR-FT^2)		BOUNDARY TEMP. (°F)	
					TOP	SIDES	SKIN	CAVITY
1	OPERATING	ELECTRONICS + HEATERS	0°	HOT	33.8	16.0	-23	75
2	OPERATING	ELECTRONICS + HEATERS	± 73½°	COLD	18.2	13.9	-75	0
3	STANDBY	HEATER ONLY	± 73½°	COLD	18.2	13.9	-75	0
4	SURVIVAL	NONE	± 73½°	COLD	18.2	13.9	-75	0
5	SURVIVAL	NONE	0°	HOT	26.8	12.9	-23	75
6	PRE-DOCKING	NONE	± 73½°	HOT	128	13.9	250	75
7	PRE-DOCKING	ELECTRONICS ONLY.	± 73½°	HOT	128	13.9	250	75

FIG. 2 THERMAL/VAC. TEST PARAMETERS


EPS ENG TEST UNIT
THERMAL TEST
CASE #2
OPERATING - COLD ORBIT
○ - PACKAGE TEMP
△ - DETECTOR TEMP
START LN_2 FLOW
TIME HOURS
9-27-71
15.37 Watts
21.8 Watts
EPS HEATER TURNED ON
TEMPERATURE °C
POWER DISSIPATED WATTS
+40
+30
+20
+10
0
-10
-20
-30
20
10
0300
0500
0700
0900
1100
1300
1500
1700
1900

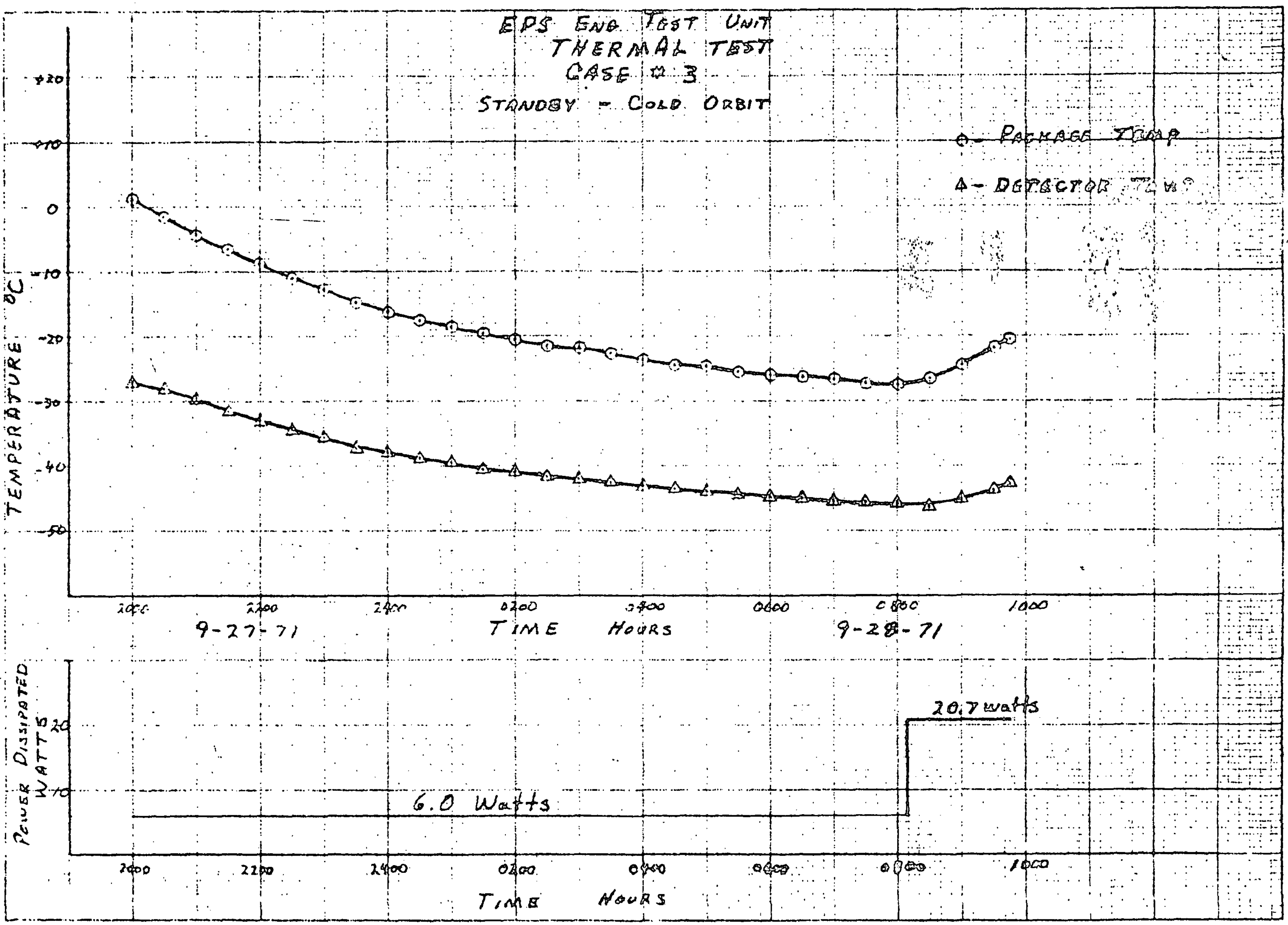
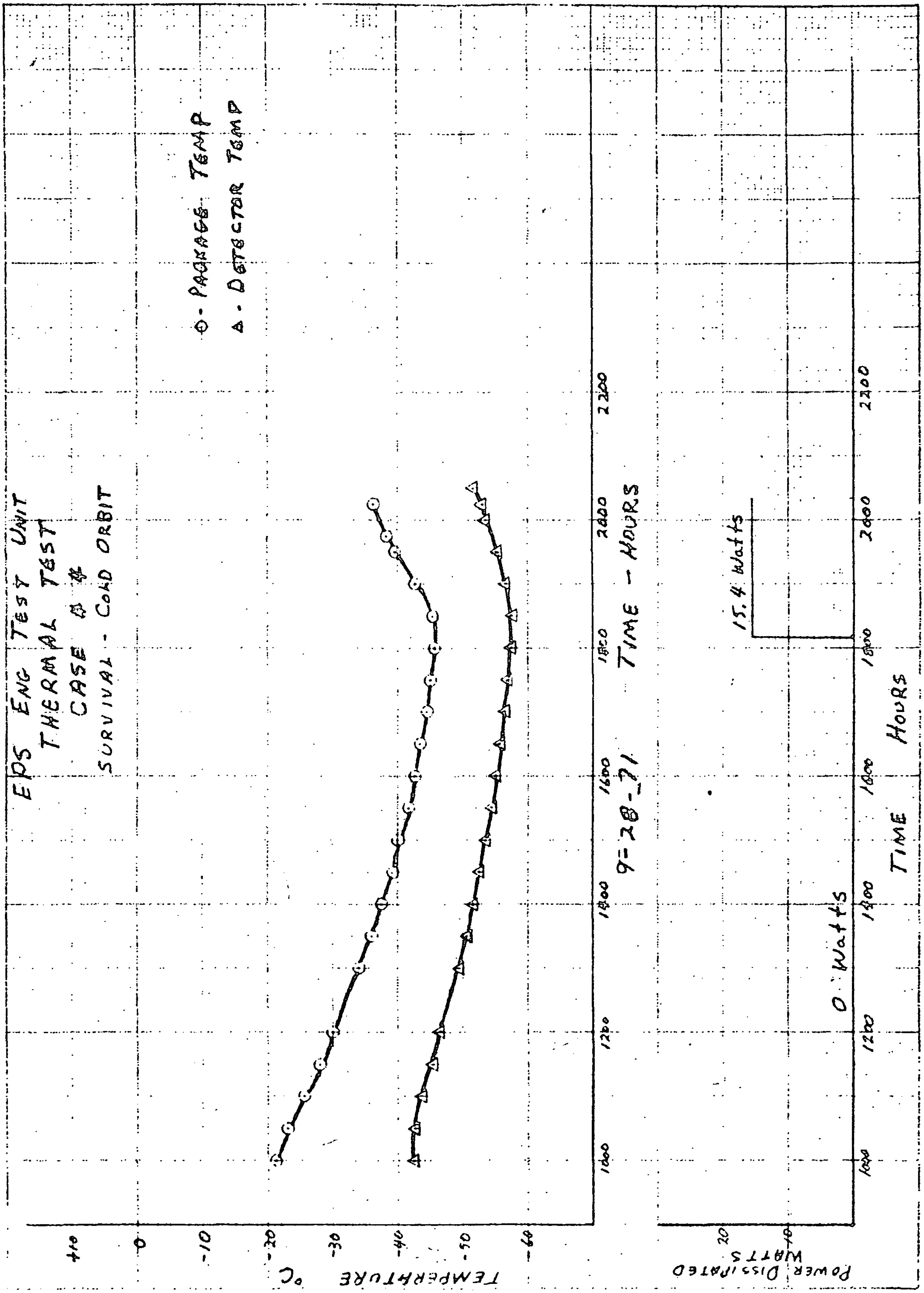

EPS ENG TEST UNIT
THERMAL TEST
CASE # 3
STANDBY - COLD ORBIT
○ - PACKAGE TEMP
△ - DETECTOR TEMP
+20
+10
0
-10
-20
-30
-40
-50
TEMPERATURE °C
2000
2200
2400
0200
0400
0600
0800
1000
9-27-71
TIME HOURS
9-28-71
POWER DISSIPATED WATTS
20
10
20.7 watts
6.0 Watts
TIME HOURS

FIG. 4



EPS ENG TEST UNIT
THERMAL TEST
SURVIVAL - COLD ORBIT
⊙ - PACKAGE TEMP
△ - DETECTOR TEMP
9-28-71
TIME - HOURS
TEMPERATURE °C
+10
0
-10
-20
-30
-40
-50
-60
1000
1200
1400
1600
1800
2000
2200
15.4 Watts
0 Watts
TIME HOURS
POWER DISSIPATED WATTS
20
10

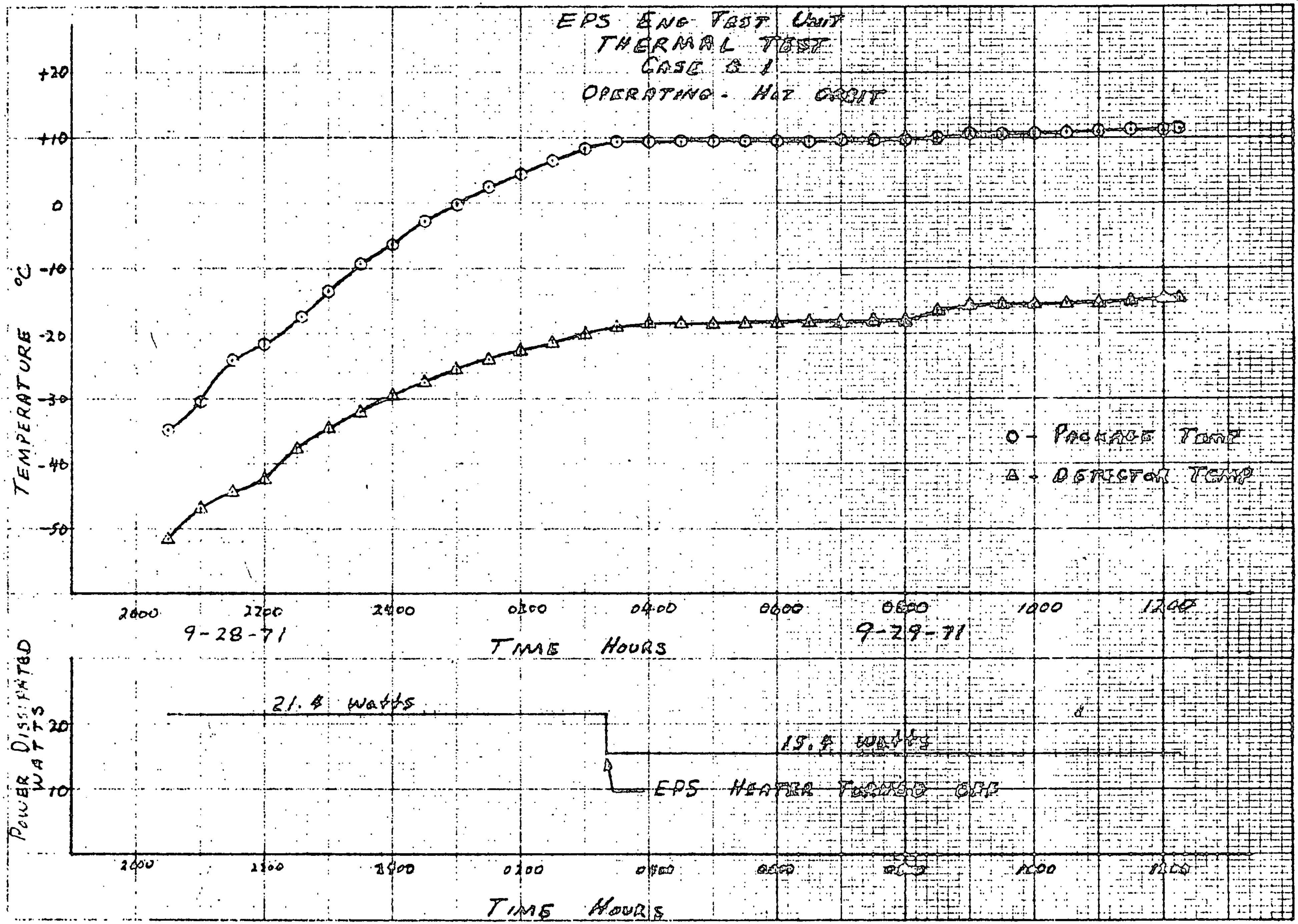

EPS ENG TEST UNIT
THERMAL TEST
CASE B 1
OPERATING - HOT ORBIT
+20
+10
0
-10
-20
-30
-40
-50
TEMPERATURE °C
O - PACKAGE TEMP
Δ - DETECTOR TEMP
2000
2200
2400
0200
0400
0600
0800
1000
1200
9-28-71
9-29-71
TIME HOURS
POWER DISSIPATED WATTS
20
10
21.4 watts
15.4 watts
EPS HEATER TURNED OFF
TIME HOURS

FIG. 1

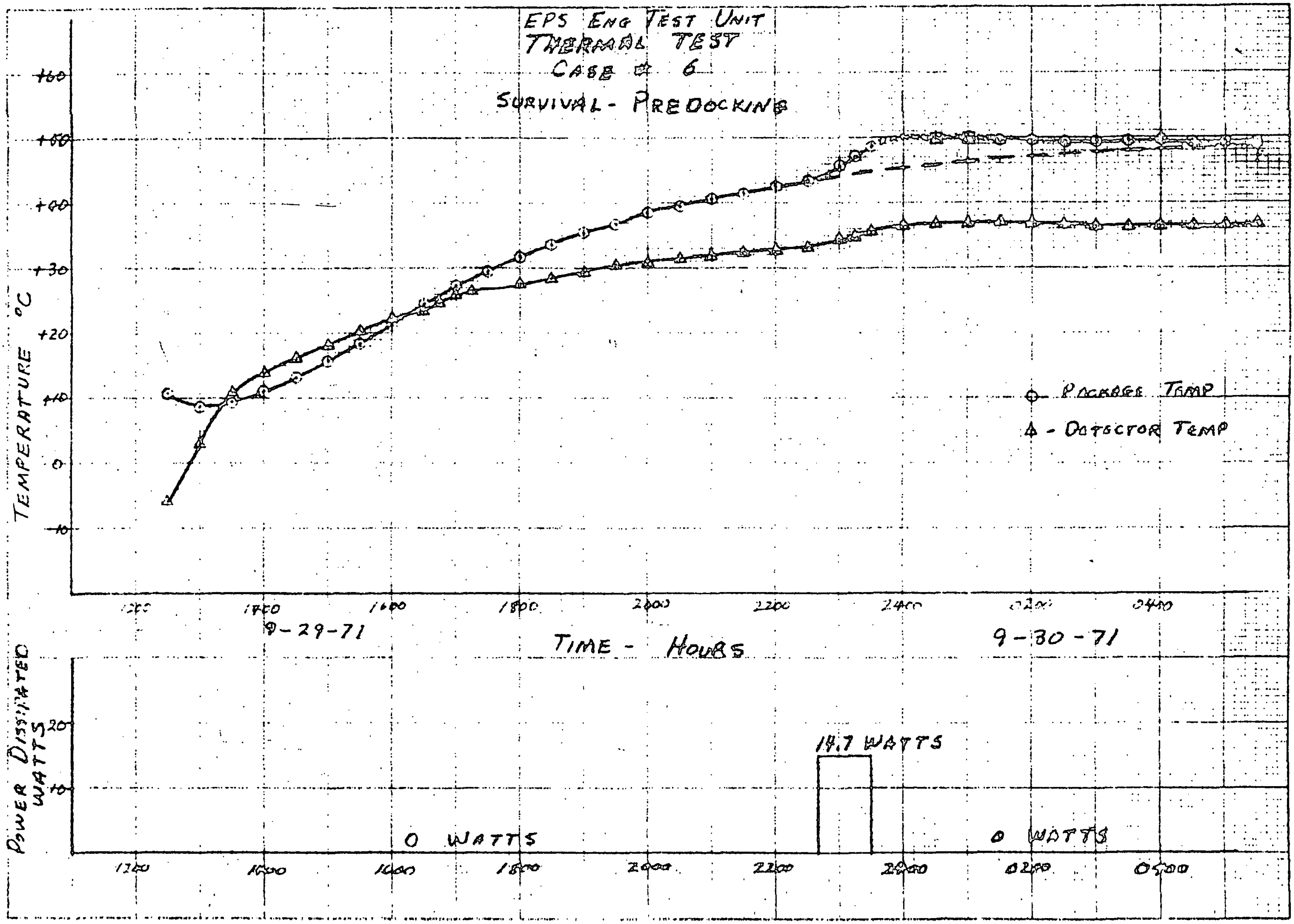

EPS ENG TEST UNIT
THERMAL TEST
CASE # 6
SURVIVAL - PREDOCKING
PACKAGE TEMP
DETECTOR TEMP
TEMPERATURE °C
+60
+50
+40
+30
+20
+10
0
-10
1200
1400
1600
1800
2000
2200
2400
0200
0400
9-29-71
TIME - HOURS
9-30-71
POWER DISSIPATED WATTS
20
10
0 WATTS
14.7 WATTS
0 WATTS
0500

FIG. 7

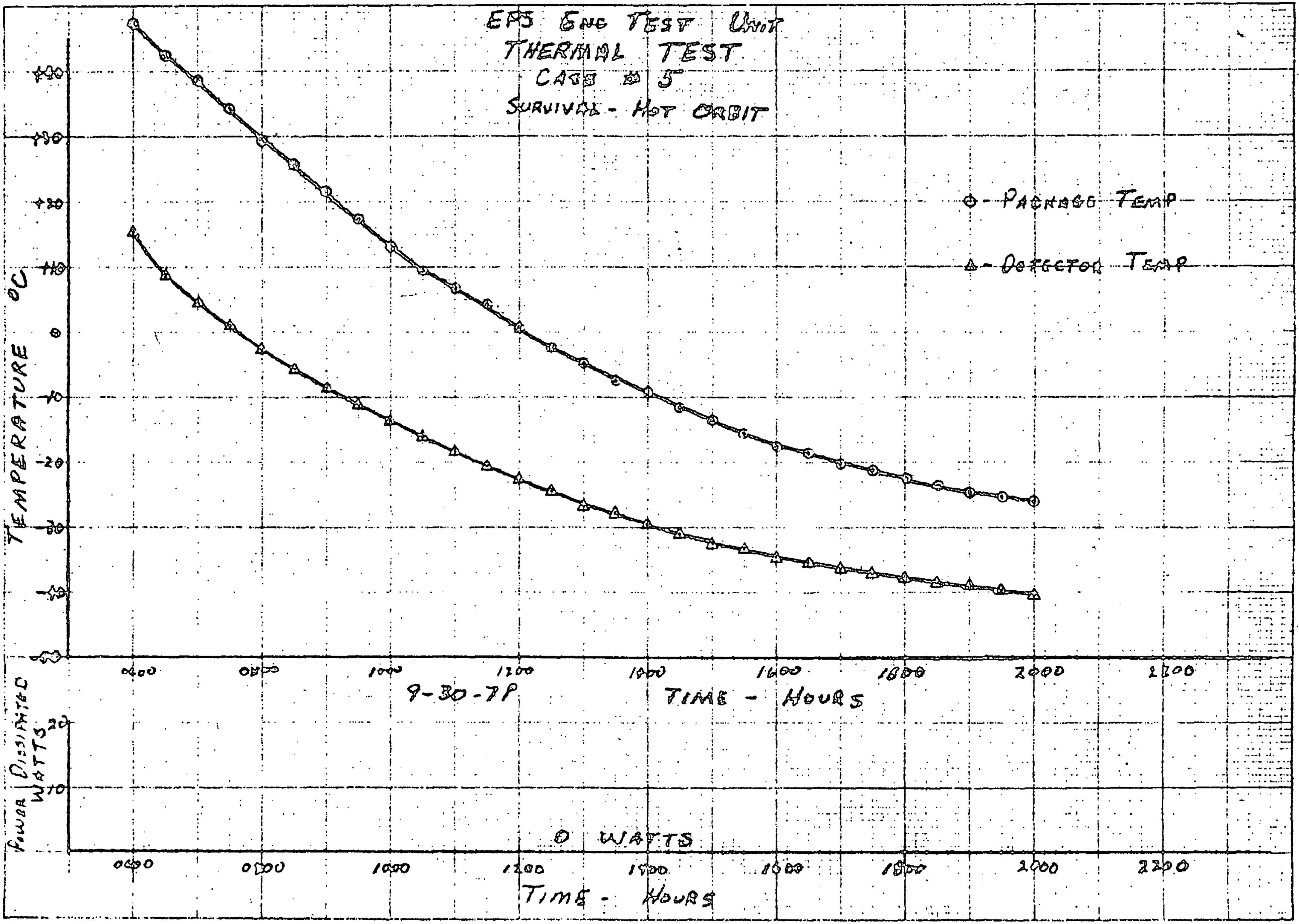

EPS ENG TEST UNIT
THERMAL TEST
CASE 5
SURVIVAL - HOT ORBIT
○ - PACKAGE TEMP
△ - DETECTOR TEMP
TEMPERATURE °C
+40
+30
+20
+10
0
-10
-20
-30
-40
0600
0800
1000
1200
1400
1600
1800
2000
2200
9-30-78
TIME - HOURS
POWER DISSIPATED WATTS
20
10
0 WATTS
0600
0800
1000
1200
1400
1600
1800
2000
2200
TIME - HOURS

FIG. 8

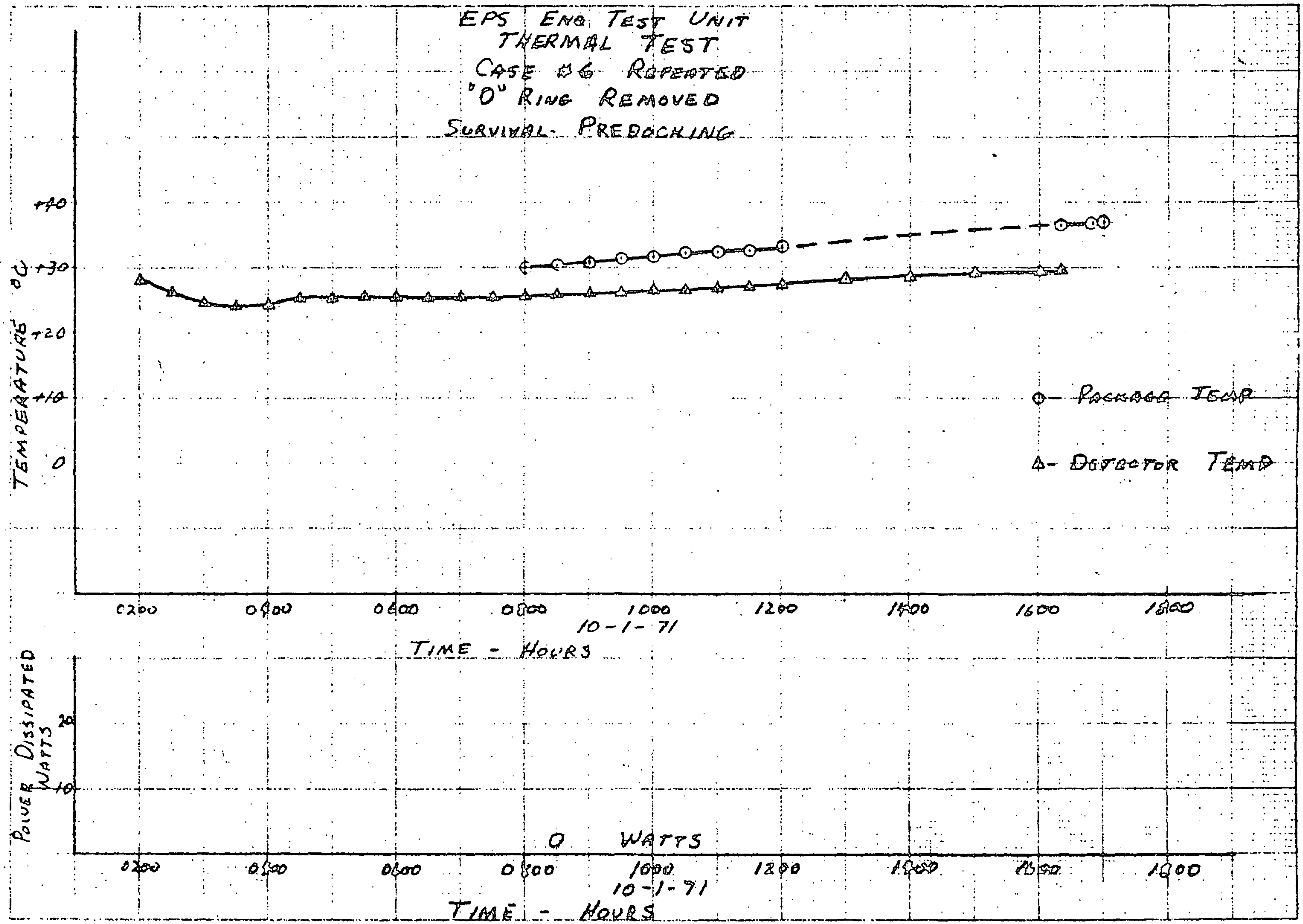

EPS Eng. Test Unit
Thermal Test
Case #6 Repeated
"O" Ring Removed
Survival- Predocking
+40
+30
+20
+10
0
Temperature °C
Package Temp
Detector Temp
0200
0400
0600
0800
1000
10-1-71
1200
1400
1600
1800
Time - Hours
Power Dissipated Watts
20
10
0 Watts

FIG. 9

TEMPERATURE LIMITS

Mode	Detectors	Electronics Package
Standby (0 Watts)	-58°F to +96°F (-50°C to +35.5°C)	-67°F to +185°F (-55°C to +85°C)
Standby (6 Watts)	-58°F to +96°F (-50°C to +35.5°C)	-40°F to +185°F (-40°C to +85°C)
Operating (13.4 Watts)	-58°F to +50°F (-50°C to +10°C)	-13°F to +77°F (-25°C to +25°C)

Figure 10

TEST CASE	CONDITIONS	Predicted Temp.*		Actual Temp.	
		PKG.	DET.	PKG.	DET.
1	Operating - Hot Orbit Power = Electronics	+79°F (+26.1°C)	+44°F (+6.7°C)	+52.3°F (+11.3°C)	+5.3°F (-15.4°C)
2	Operating - Cold Orbit Power - Electronics + Heater A/R	+20°F (-6.7°C)	-12°F (-24.4°C)	+37.2°F (+2.9°C)	-16.5°F (-26.0°C)
3	Standby - Cold Orbit Power - Heater	-34°F (-36.7°C)	-52°F (-46.7°C)	-17.7°F (-27.6°C)	-50.7°F (-45.9°C)
4	Survival - Cold Orbit Power - None	-100°F (-73.3°C)	-100°F (-73.3°C)	-50.3°F (-45.7°C)	-71.2°F (-57.4°C)
5	Survival - Hot Orbit Power - None			-14.8°F (-26.0°C)	-40.3°F (-40.2°C)
6	Survival - Pre-Docking Power - None	+75°F (+23.9°C)	+75°F (+23.9°C)	+120.2°F (+49.0°C)	+97.6°F (+36.4°C)
6 Re-Run	Survival - Pre-Docking Power - None	+75°F (+23.9°C)	+75°F (+23.9°C)	+97.7°F (+36.5°C)	+85.2°F (+29.6°C)

*Worst case analysis.

Test Cases 4 and 5 - Not normal operate modes since heater automatically turns on @ 0°C.

Figure 11 - Predicted and Actual Temperatures

Appendix A

Thermal-Vac Test Data

EPS Eng Test Unit
Thermo-Vac Data
Test Case 2

Date	Time	PMG Temp °C	Det Temp #1 °F	Det Temp #1 °C	Det Temp #2 °F	Det Temp #2 °C	Heater Status	
9-27-71	0300	36	—	—	—	—	OFF	Start Pump down - No LN2
	0330	38	—	—	—	—		
	0400	40	—	—	—	—		
	0430	41	—	—	—	—		Started LN2
	0445	—	74.5	23.6				0515 51.5
	0500	—	59.9	15.6				0530 45.7 – 7.6
	0845	23.0	12.5	-10.9	14.8			0545 41.3 / 0600 37.5 – 3.1
	0912	21.2	—	—	—			0615 34.2
	0930	19.9	7.9	[illegible]	10.3			0630 31.3 – 0
	0945	18.7	6.6	-14.1	8.8			0700 26.0 – -3.3
	1000	17.8	5.3	[illegible]	7.5			0730 21.5 – -5.8
	1015	16.8	3.9	[illegible]	6.1			0800 17.6 – -8.0
	1030	16.0	2.5	-16.4	4.9			0815 15.8
	1045	14.8	1.4	[illegible]	3.7			0830 14.0 – -10.0
	1100	14.0	.2	-17.7	2.5			
	1115	13.0	-1.0	-17.4	1.4			
	1130	12.4	-2.1	[illegible]	.2			
	1145	11.4	-3.2	[illegible]	-.9			
	1200	10.7	-4.2	[illegible]	-1.9			
	1245	8.6	-7.2	[illegible]	-4.8			
	1300	7.1	-8.1	[illegible]	-5.9			
	1315	7.0	—	—	—			
	1330	6.8	-9.6	[illegible]	-7.4			
	1345	6.1	-10.5	[illegible]	-8.2			
	1400	5.5	-11.2	[illegible]	-9.0			
	1415	4.9	-12.0	[illegible]	-9.8			
	1430	4.5	-12.7	[illegible]	-10.5			
	1445	3.9	-13.4		-11.1			
	1500	3.4	-14.0	[illegible]	-11.9			
	1515	2.8	-14.7		-12.5			
	1530	2.5	-15.3	-26.0	-13.0			
	1545	2.0	-15.9		-13.7			
	1600	1.6	-16.4	[illegible]	-14.3			
	1615	1.0	-17.0		-14.8			
	1630	.9	-17.5	[illegible]	-15.3			
9-27-71	1645	.4	—	—	—	—	OFF	

EPS Eng Test Unit

Thermo-Vac Data

Test Case 2 and 3

	Time	PKG Temp °C	Det Temp #1 °F	Det Temp #1 °C	Det Temp #2 °F	Det Temp #2 °C	Heater Status	
9-27-71	1700	0	-18.3	-27.9	-16.2		OFF	
	1720	-0.5	—		—		ON	
	1730	-0.3	-19.1	-28.3				
	1745	0	-19.1	-28.3	—			
	1800	0.5	-18.9	-28.3	-16.7			
	1840	1.5	-18.0	-27.7	-15.7			
	1900	2.0	-17.4	-27.4	-15.1			
	1937	2.9	-16.5	-26.9	-14.3		ON	Turned Elec & Det Pwr off - Start Test case #3
	2000	1.2	-16.6	-27	-14.5		ON	
	2030	-1.4	-18.7	-28	-16.5			
	2100	-4.1	-21.7	-29.7	-19.6			
	2130	-6.6	-24.4	-31.6	-22.3			
	2200	-8.9	-27.3	-33	-25.4			
	2230	-11.0	-29.8	-34.3	-28.0			
	2300	-12.8	-32.1	[illegible]	-30.3			
	2335	-14.9	-35.2	-37.3	-33.3			
9-27-71	2400	-16.1	-36.2	-37.9	-34.5			
9-28-71	0030	-17.7	-37.9	-38.8	-36.2			
	0100	-18.7	-39.3	-39.5	-37.7			
	0130	-19.8	-40.7	-40.5	-39.1			
	0200	-20.5	-41.9	-41	-40.3			
	0230	-21.3	-42.8	-41.6	-41.1			
	0300	-21.9	-43.5	42	-41.8			
	0330	-22.7	-44.4	-42.5	-42.8			
	0400	-23.5	-45.4	-43	-43.7			
	0430	-24.3	-46.2	-43.5	-44.6			
	0500	-24.7	-46.9	-43.7	-45.4			
	0530	-25.3	-47.7	-44.2	-46.1			
	0600	-25.9	-48.3	44.7	-46.8			
	0630	-26.3	-49.0	[illegible]	-47.5			
	0700	-26.7	-49.5	[illegible]	-48.0			
	0730	-27.2	-50.1	[illegible]	-48.6			
9-28-71	0800	-27.6	-50.7	[illegible]	-44.2		ON	

EPS Eng Test Unit
Thermo-Vac Data
Test Case 3 & 4

Date	Time	PKG Temp °C	Det Temp #1 °F	Det Temp #1 °C	Det Temp #2 °F	Det Temp #2 °C	Heater Status	
9-28-71	0810	—	—	—	—	—	ON	Turned on Elect PWR, Det PWR OFF
	0830	-26.5	-50.9	-46.2	-49.4			
	0900	-24.4	-49.3	-45.1	-47.7			
	0930	-21.8	-46.7	-43.8	-45.1			
9-28-71	0945	-20.6	—	—	—	—	ON	Turned All PWR OFF START Test Case # 4
9-28-71	1000	-21.2	-44.2	-42.3	-42.4		OFF	
	1015	-22.3	-44.0	-42.2	-42.3			
	1030	-23.0	-44.7	[illegible]	-42.9			
	1045	-24.4	-45.6	-43	-44.0			
	1100	-25.4	-46.8	[illegible]	-45.2			
	1115	-27.2	-48.1	[illegible]	-46.6			
	1130	-28.0	-49.3	[illegible]	-47.8			
	1145	-29.1	-50.7	[illegible]	-49.1			
	1200	-30.0	-51.9	[illegible]	-50.4			
	1300	-34.1	-56.8	[illegible]	-55.6			
	1315	-35.3	-58.0		-56.7			
	1330	-36.0	-58.9	[illegible]	-57.7			
	1345	-36.7	-60.0		-58.8			
	1400	-37.4	-61.0	[illegible]	-59.7			
	1415	-38.2	-61.7		-60.5			
	1430	-39.1	-62.6	[illegible]	-61.4			
	1445	-39.4	-63.3		-62.3			
	1500	-39.9	-64.2	[illegible]	-63.1			
	1515	-40.6	-64.8		-63.7			
	1530	-41.7	-65.7	[illegible]	-64.4			
	1545	-42.1	-66.3		-65.3			
	1600	-42.4	-67.0	[illegible]	-65.8			
	1615	-42.8	-67.6		-66.5			
	1630	-43.2	-68.1	[illegible]	-67.1			
	1645	-43.6	-68.7		-67.6			
	1700	-44.2	-69.2	[illegible]	-68.2			
-28-71	1715	-44.5	-69.7		-68.7		OFF	

EPS Eng. Test Unit
Thermo-Vac Data
Test Case #EL

Date	Time	PKG Temp °C	Det Temp #1 °F	Det Temp #1 °C	Det Temp #2 °F	Det Temp #2 °C	Heater Status	
9-28-71	1730	-44.9	-70.3	-57	-69.2		OFF	
	1745	-45.3	-70.7		-69.7		↓	
	1800	-45.7	-71.2	-57.4	-70.2		OFF	
								1810 Started taking Data - Elect Power ON
	1815	-45.6	-71.5	[illegible]	-70.6		OFF	
	1830	-45.1	-71.5	[illegible]	-70.4		↑	
	1900	-42.4	-70.1	-56.7	-69.0			
	1915	-40.1	-68.9		-67.8			
	1930	-39.7	-67.5	[illegible]	-66.4			
	1945	-38.4	-66.2		-65.0		↓	
	2015	-36.3	-63.3	-53	-62.1		OFF	
	2020	-35.7					ON	Start Test Case #1 All pwr ON, BRN changing S/C skin & cavity Temp
	2030	-34.8	-60.6	[illegible]	-59.4		ON	BRN set up conditions for T.C. #5
	2100	-30.3	-52.2	[illegible]	-52.0		ON	
	2130	-24.0	-47.3	[illegible]	-46.0		ON	
	2200	-21.7	-44.1	[illegible]	-39.5		ON	
	22:30	-17.3	-35.4	[illegible]	-34.0		ON	
	23:00	-13.3	-30.3	[illegible]	-28.7		ON	
	23:30	-9.4	-25.6	[illegible]	-23.9		ON	
9-28-71	24:00	-6.1	-21.2	[illegible]	[illegible]		ON	
9-29-71	00:00	See 2400, 9/28	See 2400, 9/28					
	0030	-2.78	-17.5	[illegible]	[illegible]		ON	
	01:00	-0.04	[illegible]	[illegible]			ON	
	01:30	+2.4	[illegible]	[illegible]	[illegible]		ON	[illegible] test condition [illegible]
	02:00	+4.54	[illegible]	[illegible]	[illegible]		ON	(For T.C. #5)
	02:30	+6.5	[illegible]	[illegible]	[illegible]		ON	
	03:00	+8.25	[illegible]	[illegible]	-1.7		ON	[illegible] HEATER TURN-OFF TEMP. 9.3°C
	03:30	+9.41	[illegible]	[illegible]	[illegible]		OFF	
	04:00	+9.44	[illegible]	[illegible]	[illegible]		OFF	
	04:30	+9.54	[illegible]	[illegible]	[illegible]		OFF	

EPS Eng Test Unit
Thermo-Vac Data
Test Case 1 & 6

Dt	Time	PKG Temp °C		Det Temp #1 °F	Det Temp #1 °C	Det Temp #2 °F	Det Temp #2 °C	Heater Status	
9-29-71	05.30	+9.6°		-.8	-18.2	+1.1		OFF	
	06.00	+9.72°		-.7	-18.2	+1.5		OFF	
	06.30	+9.72°		-.6	[illegible]	+1.5		[illegible]	
	07.00	+9.80°		[illegible]	[illegible]	[illegible]		OFF	
	07.30	+9.72°		-.4	-18	[illegible]		OFF	
	08.00	+9.72°		-.4	-18	+1.8		OFF	changed Chamber Cont to TC#1 @ 0805
	0830	+10.0		2.5	[illegible]	4.4		OFF	
	0900	+10.3		3.4	[illegible]	5.2		OFF	
	0930	+10.5		4.0	[illegible]	5.9		OFF	
	1000	+10.7		4.3	[illegible]	6.2		OFF	
	1030	+10.9		4.6	[illegible]	6.5		OFF	
	1100	+11.0		4.8	[illegible]	6.7		OFF	
	1130	+11.2		5.0	[illegible]	6.9		OFF	
	1200	+11.3		5.2	[illegible]	7.0		OFF	
	1215	+11.3		5.3	[illegible]	7.1		OFF	
									End of T.C. #1 Go to T.C. #6 Cond. @ 1215. All PWR OFF
	1230	+10.8		21.3	[illegible]	22.3		OFF	
	1300	+8.8	2.942	37.3	+3	37.2			
	1330	+9.5	2.976	51.7	11	51.7			
	1400	+11.0	3.049	57.3	14	57.3			
	1430	+13.2	3.162	61.1	[illegible]	61.1			
	1500	+15.9	3.294	64.8	[illegible]	64.7			
	1530	+18.6	3.431	68.7	[illegible]	68.3			
	1600	+21.1	3.577	71.8	[illegible]	71.8			
	1630	+24.6	3.734	74.8	[illegible]	74.9			
	1700	+27.4	3.870	78.7	[illegible]	78.8			
	1730	+29.7	[illegible]	--	—				
	1800	+31.7	4.086	[illegible]					
	1830	+33.6	4.177		[illegible]				
	1900	+35.4	4.270	84.9	[illegible]	85.2			
	1930	+36.9	4.345	86.4	[illegible]	86.9			
9-29-71	2000	+38.4	4.412	87.7	[illegible]	88.2		OFF	
	2030	+39.4	4.472	88.5	[illegible]	89.0			

EPS Eng Test Unit
Thermo-Vac Data
Test Case 6 & 5

[illegible]	Time	PKG Temp °C		Det #1 °F	Det #1 °C	Det #2 °F	Det #2 °C	Heater status	
9-29-71	21:00	+40.6	4530	[illegible]	[illegible]	90.1			
	21:30	41.5	[illegible]	[illegible]	[illegible]	91.0			
	22:00	42.4	[illegible]	91.2	32.9	91.8			
	22:30	43.2	4658	91.9	[illegible]	92.6			Elect PWR on @ ~~2240 to test~~
	23:00	45.7	4745	93.5	34.2	94.3			INSTRUMENT
	2315	47.1	4.853	94.7	34.8	95.4			
	23:30	48.8	4.941	96.1	[illegible]	96.9			Turned Elect PWR
	2400	—	—	97.9	[illegible]	98.8			off @ 2330
9-30-71	0000	50+	5.00	98.3	36.9	99.3			
	0100	50+	5.00	98.4	37	99.4			
	0130	49.9	4.995	98.4	37	99.3			
	0200	49.7	4.985	98.3	36.9	99.2			
	0230	49.6	4.980	98.0	[illegible]	98.9			
	0300	49.4	4.970	97.8	[illegible]	98.9			
	0330	49.3	4.966	97.8	[illegible]	98.7			
	0400	49.2	4.960	97.7	36.4	98.6			
	0430	49.1	4.956	97.6	36.4	98.5			
	0500	49.1	4.956	97.6	36.4	98.4			
	0530	49.0	4.951	97.6	36.4	98.5			CONCLUDED - STABILIZED. SET UP TEST CASE 5.
	0600	47.12	4.858	59.6	[illegible]	62.5			
	0630	42.28	4.614	48.1	[illegible]	50.9			
	0700	38.46	4.423	40.5	[illegible]	43.1			
	0730	34.33	4.218	33.8	1	36.4			
	0800	29.28	3.964	27.6	[illegible]	30.3			
	0830	25.86	3.793	22.0	[illegible]	24.4			
	0900	21.46	3.573	16.8	[illegible]	19.3			
	0930	17.3	3.367	12.0	-11	14.4			
	1000	13.2	3.162	7.6	[illegible]	9.7			
	1030	9.62	2.981	3.1	-16	5.2			
	1100	6.88	2.844	-0.8	-18	1.2			
	1130	4.24	2.712	-4.9	[illegible]	-2.8			
	1200	+0.6	2.532	-8.5	[illegible]	-6.5			
	1230	-2.2	2.390	-12.0	[illegible]	-10.1			
	1300	-4.7	2.262	-15.2	[illegible]	-13.4			
	1330	-7.5	2.130	-18.2	[illegible]	-16.5			
	1400	-9.35	2.033	-21.0	[illegible]	-19.3			

EPS Eng Test Unit
Thermo-Vac Data
Test Case 5 & 6 repeated

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ADC CHECK @ .85°C INPUT 4.900 OUT 4.888

Date	Time	PHG Temp °C		Det Temp #1 °F	Det Temp #1 °C	Det Temp #2 °F	Det Temp #2 °C	Heater status	
9/30/71	1430	-11.6	1.920	-23.5	-30.8	-11.9		N/A	
	1500	-13.5	1.823	-25.9	-32.2	-24.3			
	1530	-15.5	1.725	-28	-33.3	-26.5			
	1600	-17.8	1.608	-30.2	-34.5	[illegible]			
	1630	-18.6	1.569	-31.6	-35.3	-30.2			
	1700	-20.1	1.498	-33.1	36.2	31.7			
	1730	-21.1	1.442	34.7	37	-33.2			
	1808	-22.6	1.369	-36.1	37.9	-34.7			
	1835	-23.6	1.320	-37.4	38	-36.1			
	1905	-24.5	1.276	38.6	39	-37.2			
	1930	-25.3	1.237	-39.5	39.7	-38.2			
	2000	-26.0	1.197	-40.3	40.3	-39.2			opened Chamber, Removed "O" Ring under flange, Painted bottom of cavity black
	Started repeat of T.C. #6 @ ~ 0200								
10-1-71	0200	—		83	[illegible]			OFF	
	0230	—		79.1	[illegible]				
	0300	—		76.4	[illegible]				
	0330	—		75.9	[illegible]				
	0400	—		76.5	[illegible]				
	0430	—		77.1	[illegible]				
	0500	—		77.5	[illegible]				
	0530	—		78.0	[illegible]				
	0600	—		78.1	[illegible]				
	0630	—		77.6	[illegible]				
	0700	—		77.8	[illegible]				
	0730	—		78.1	[illegible]				
	0800	30.0	4.003	78.5	[illegible]				
	0830	30.3	4.018	78.8	[illegible]				
	0900	30.9	4.047	79.2	[illegible]				
	0930	31.4	4.071	79.6	[illegible]				
	1000	31.8	4.091	79.9	[illegible]				
	1030	32.2	4.110	80.1	[illegible]			OFF	

EPS Eng Test Unit
Thermo-Vac Data
Test Case: Grepacker

Date	Time	PKG Temp °C		Det Temp #1 °F	Det Temp #1 °C	Det Temp #2 °F	Det Temp #2 °C	Heater status	
10-1-71	1100	32.5	4.125	80.5	11				
	1130	32.8	4.140	80.8	27.1				
	1200	33.1	4.159	81.3	27.4				
	1400	———		83.8	28.1				Change Temp of
	1500	———		84.4	29.1				Cavity to +117 °F
	1600	———		84.9	29.3				
	1620	36.5	4.326	85.2	29.6				
	1648	36.8	4.340	—					
	1658	37.0	4.350	—					

Appendix B
Power System Performance

SUMMARY OF POWER SYSTEM PERFORMANCE DURING THE EPS ENG. TEST UNIT THERMAL-VACUUM TESTING

A. INPUT FILTER

Due to the test setup (i.e., the EPS mounted inside a vacuum chamber) and a lack of the necessary test equipment, it was not possible to perform any RFI/EMI testing on the EPS during Thermal-Vacuum testing. Therefore, it is not known whether the Input Filter met its design specifications at the temperatures encountered during this test. However, since the electronic components utilized in this subsystem do not vary significantly with temperature and are insensitive to vacuum, and since this unit had already passed an EMI test at room temperature, it is assumed that the Input Filter would have allowed the EPS to pass an EMI test at any temperature within the operating limits specified for the instrument.

Since both power supplies and the Heater Control circuit were always within specification (see below), the Input Filter could not have modified the primary power (+28 Vdc) to these circuits. Therefore, the conclusion reached is that the Input Filter performed as expected.

B. DETECTOR BIAS SUPPLY

The Detector Bias Supply met all of the performance specifications during the Thermal-Vacuum testing. A summary of its performance compared to the required specifications is given below.

Specification (Ref. EPS-41)		Peformance Thermal-Vacuum Test
Input Voltage:	27.5 ± 2.5Vdc	Operated at 28 ± 4Vdc
Input Current:	$I_{in} \leq 30$ ma @ 28Vdc	$I_{in} \leq 25$ ma
Oper. Temp Range:	-25°C to +25°C	Operated from -45°C to +43°C
Surv. Temp Range:	-50°C to +50°C	
Output Voltage:	350 ± 17.5Vdc	346.9 ± 0.9Vdc over Temp range of -45°C to +43°C

C. LOW VOLTAGE POWER SUPPLY

The LVPS met most of the required specifications during the Eng. Test Unit Thermal-Vacuum testing. The summary below gives actual performance and the required performance.

Specification (Ref. EPS-45)		Performance Thermal-Vacuum Test
Input Voltage:	27.5 ± 2.5Vdc	Operated from 24 to 31Vdc
Input Current:	$I_{in} \leq 557$ ma	$I_{in} \leq 550$ ma
Oper. Temp Range:	-25°C to +25°C	Operated from -45°C to +43°C
Surv. Temp Range:	-50°C to +50°C	

Specified Outputs:	Measured Outputs	
$+8 {}^{+0.2}_{-0.0}$ Vdc	8.05 to 8.08	$-27°C \leq T \leq 23°C$
$-8 {}^{+0.2}_{-0.0}$ Vdc	-8.08 to -8.13	"
+5 ± 0.3 Vdc	5.00 to 5.03	"
-5 ± 0.3 Vdc	*-5.258 to -5.317	"
+25 ± 2.0 Vdc	25.56 to 25.64	"
-15 ± 2.0 Vdc	-16.63 to -16.73	"
3.0 ± .01 Vdc	3.003 to 3.009	"

*Note that the -5 Vdc output was out of specification. This output was out of spec. at room temperature (V_{out} = -5.317, spec. allows -5.300). This is a result of generating both the +5 output and the -5 output from one secondary winding on the LVPS transformer. Since the load current for the +5 is approximately 900 ma and the load current for the -5 V output is only approximately 120 ma there will be a considerable difference in the two output voltages. It was decided to set the output voltages of this winding with the +5 V output (i.e., adjust the number of turns on this winding to get a minimum of +5.00 Vdc out and take whatever comes out for the -5 V). Since the -5 V output is out of specification by only 0.3% worst case, this is acceptable.

D. HEATER CONTROL

During the Thermal-Vacuum testing, the internal skin heaters turned on during Test Case #2 (operating during a cold orbit) when the internal package temperature had reached -0.5°C. When the additional six watts were dissipated within the EPS, the package temperature started

increasing. The temperature was monitored for an additional two hours and increased to +2.9°C during this time. It is surmised that the package temperature would have eventually reached +10°C and the heater would have turned off.

During Test Case #1 (operating during a hot orbit) the package temperature started out at -35°C. With all electronics power on and the heaters on, the package temperature increased to +9.5°C in seven hours. At this point, the heaters turned off and the package temperature immediately stabilized at +10°C where it remained for the remaining eight hours of the test.

Since during the course of the Thermal-Vacuum testing, the EPS package temperature ranged between -45°C and +43°C, it is obvious that the Heater Control Subassembly will operate over and survive this temperature range.

A. NOT CORRECTED FOR ADC ERRORS

Temp °C	+5 Volt	+8 Volt	-8 Volt	+25 Volt	+350 Volt	-15 Volt	-5 Volt	+3 Volt
+43	5.044	8.114	-8.165	25.70	346.6	-16.62	-5.329	3.003
+23	5.034	8.084	-8.131	25.64	346.1	-16.63	-5.317	3.009
+11	5.024	8.064	-8.102	25.59	345.6	-16.62	-5.297	2.999
0	5.014	8.054	-8.096	25.54	345.6	-16.63	-5.281	2.996
-27	4.976	8.006	-8.038	25.43	345.6	-16.64	-5.232	2.993
-45	4.916	7.928	-7.958	25.27	346.1	-16.53	-5.142	2.987

B. CORRECTED FOR ADC ERRORS

Temp °C	+5 Volt	+8 Volt	-8 Volt	+25 Volt	350 Volt	-15 Volt	-5 Volt	+3 Volt
+43	5.044	8.114	-8.165	25.65	346.2	-16.62	-5.329	2.999
+23	5.034	8.084	-8.131	25.64	346.1	-16.63	-5.317	3.009
+11	5.032	8.084	-8.131	25.63	346.3	-16.67	-5.317	3.003
0	5.028	8.078	-8.117	25.62	346.8	-16.66	-5.307	3.005
-27	5.000	8.046	-8.078	25.56	347.3	-16.73	-5.258	3.007
-45	4.940	7.968	-7.998	25.40	347.8	-16.62	-5.168	3.001

TABLE I. EPS ENG TEST UNIT PERFORMANCE DURING THERMAL-VACUUM TEST.

Appendix C
Functional Test Results

Due to the time required to record a complete set of data (approximately 45 minutes) the temperatures at a given time may not agree exactly with those on the log sheets in Appendix A. No effort has been made to reconcile these discrepancies. The data is presented as recorded.

Date	Time of Day	Test Conditions	Disc. Ref.	Outside Temp	Det Temp	Package Temp
9/22/71	2200	Initial Checkout in Bldg. 33, no outer housing or det. plate		Room	Room	Room
9/27/71	0150	EPS sitting on table in front of test chamber/moving into test chamber		Room	Room	Room
9/27/71	1710	Test Case #2	2.498		-17°F	0°C
9/28/71	0835	End of Test Case #3	2.493		-52°F	-27°C
9/28/71	1908	End of Test Case #4			-70°F	-42.4°C
9/29/71	1110	End of Test Case #1 (Det Bias On)			+5°F	+11.0°C
9/29/71	2240	Test Case #6 (not in thermal equil)	2.502		+92	+43.2°C
10/3/71	1330	After second Test Case #6		Room	Room	+33.6°C

Date	Time of Day	Test Conditions	Outside Temp	Plate Temp	Package Temp
9/22/71	2055	Initial checkout in Bldg. 33, no outer housing or top plate	Room	Room	Room
9/27/71	0025	Initial checkout in Bldg. 33, sitting on table in front of chamber	Room	Room	Room
9/27/71	1615	Test Case #2		-15°F	0°C
9/28/71	0800	End of Test Case #3		-51°F	-27°C
9/28/71	1800	End of Test Case #4		-70°F	-45°C
9/29/71	1100	End of Test Case #1		+5°F	11.0°C
9/29/71	2230	Test Case #6 (not in thermal equil)		92°F	+43.2°C
10/3/71	1430	After second Test Case #6			+33.6°C

FOLDOUT FRAME /

Discriminator Values

P.D. 2005 output required for 50% counting								(BTE calls P6)	(BTE) calls P5)	
E1x10	P1	E2x10	P2	E3x10	P3	E4x10	P4	P5	P6	
-1.4530	-3.7190	-1.3810	-4.3610	-1.3480	-4.2290	-1.2730	-2.2985	-6.7770	-2.5470	
-1.4542	-3.7247	-1.3844	-4.3685	-1.3510	-4.2370	-1.2760	-2.2971	-6.7873	-2.5483	
-1.4190	-3.6145	-1.3467	-4.2424	-1.3105	-4.1289	-1.2445	-2.2670	-6.6290	2.4924	Package
1.3940	-3.5436	-1.3150	-4.1449	1.2740	3.9989	1.2160	-2.1900	6.4600	2.4300	Temp was
1.3807	3.5159	1.2928	4.1006	1.2560	3.9445	1.2000	2.1640	6.3710	2.3986	was 48.89
1.4300	3.6411	1.360	4.2752	1.3210	4.141	1.2560	2.2793	6.6780	2.5230	at end
1.4460	3.6845	1.3580	4.2568	1.3190	4.1320	1.2470	2.2632	6.4730	2.4160	of runs
-1.4515	-3.7033	-1.3915	-4.3918	-1.3545	-4.2513	-1.2794	-2.2983	-6.7996	-2.5472	

ADC Values

Housekeeping +350 V Monitor P.D. Output							
0.025	0.050	0.100	1.000	2.000	3.000	4.000	4.900
0.029	0.054	0.103	1.007	2.004	3.006	4.008	4.907
0.034	0.054	0.103	1.007	2.008	3.011	4.013	4.912
0.029	0.054	0.103	1.002	2.004	3.001	3.998	4.897
0.029	0.054	0.103	1.002	1.999	2.996	3.993	4.892
0.029	0.054	0.103	1.002	1.999	2.996	3.993	4.892
0.034	0.054	0.103	1.002	2.004	3.006	4.003	4.902
0.034	0.059	0.108	1.007	2.008	3.011	4.013	4.912
0.034	0.059	0.108	1.007	2.009	3.011	4.013	4.912

FOLDOUT FRAME 2

Date	Time of Day	Test Conditions	Outside Temp	Det Temp	Package Temp
9/22/71	2125	Initial Checkout in Bldg. 33, no outer housing or detector plage	Room	Room	Room
9/27/71	0200	EPS in chamber - BRN hooking up	Room	Room	Room
9/27/71	1700	Test Case #2		-17°F	0°C
9/28/71	0835	End of Test Case #3		-51°F	-27°C
9/28/71	1800	End of Test Case #4		-70°F	-45°C
9/29/71	1100	End of Test Case #1		+5°F	+11.0°C
9/29/71	2230	Test Case #6 (not in thermal equilibrium)		92°F	+43.2°C
10/3/71	1440	After second Test Case #6			+33.6°C

Date	Time of Day		Det Temp	Package Temp	BNC Rate
9/22/71	2055	Initial Checkout in Bldg. 33, no outer housing or detector plate	Room	Room	Disconnected
9/27/71	0200	EPS in chamber	Room	Room	
9/27/71	1707	Test Case #2	-17°F	0°C	
9/28/71	0800	End of Test Case #3	-51°F	-27°C	
			-51°F	-27°C	
9/28/71	1900	End of Test Case #4	-68°F	-39°C	
	"	" "	-68°F	-39°C	
9/29/71	1140	End of Test Case #1	+5°F	+11°C	
			+5°F	+11°C	
9/29/71	2240	Test Case #6 (not in thermal equilibrium)	93.2°F	+43.2°C	
	"	" "	93.2°F	+43.2°C	
10/3/71	1455	After second Test Case #6		+33.6°C	
"	"	" "		+33.6°C	

FOLDOUT FRAME 1

Leakage Current Tests

P.D. = +30.000 Vdc					P.D = 40.000 Vdc				
A	B	C	D	E	A	B	C	D	E
3.372	3.382	1.461	3.372	1.461	4.511	4.526	1.955	4.511	1.955
3.372	3.387	1.461	3.377	1.461	4.516	4.530	1.955	4.516	1.955
3.343	3.368	1.461	3.353	1.447	4.472	4.501	1.955	4.482	1.940
3.324	3.340	1.461	3.338	1.427	4.453	4.487	1.955	4.467	1.921
3.314	3.348	1.471	3.333	1.417	4.442	4.477	1.965	4.462	1.906
3.353	3.372	1.461	3.358	1.452	4.487	4.511	1.955	4.492	1.945
3.377	3.392	1.461	3.377	1.466	4.516	4.536	1.955	4.516	1.960
3.372	3.387	1.461	3.372	1.466	4.511	4.526	1.955	4.511	1.960

Resolution Monitor Values

					BNC					
A	B	C	D	E	Rate	A	B	C	D	E
.875	1.877	0.875	1.095	1.329	7.048K	3.250	4.521	1.857	2.972	1.989
.904	1.305	0.914	1.051	1.139	7.039K	3.265	4.179	1.926	2.952	1.808
.718	.963	0.733	.963	1.920	7.037K	3.196	4.799	1.588	2.776	2.268
.718	.845	.723	.845	1.593	7.031K	3.192	4.795	1.642	2.805	2.248
.718	1.994	.723	.904	1.662	7.031K	3.196	4.775	1.642	2.810	2.385
.718	1.975	.723	.870	1.588	7.031K	3.196	4.795	1.642	2.835	2.253
.718	1.960	.723	.865	1.588						
1.105	2.737	1.173	1.227	2.673	7.031	3.421	5.000	1.691	2.933	3.177
1.007	2.742	1.168	1.007	2.654	7.031	3.421	5.000	1.691	2.928	3.182
			1.240							
1.369	4.643	3.451	2.028	4.565	7.038	3.651	5.000	3.372	3.338	4.687
1.359	4.599	3.363	1.975	4.511	7.038	3.656	5.000	3.309	3.319	4.624
.748	1.828	.733	.875	1.432	7.0368	3.192	4.658	1.711	2.830	2.126
.748	1.813	.733	.865	1.432	7.0368	3.201	4.697	1.706	2.845	2.146
1.124	2.087	1.178	1.427	1.628	7.0392	3.500	5.000	2.913	3.421	2.537
1.124	2.170	1.183	1.574	1.774	7.0392	3.500	5.000	2.913	3.440	2.507
0.923	2.434	0.973	1.188	1.442	7.0361	3.309	4.702	1.950	3.025	2.170
0.968	2.028	0.973	1.188	1.471	7.0361	3.309	4.692	1.950	3.045	2.087

FOLDOUT FRAME 2

TEST REPORT: ELECTRON-PROTON SPECTROMETER ENGINEERING TEST UNIT, VIBRATION TEST

Date	Time of Day	Test Conditions	Outside Temp	Det Temp	Package Temp
9/22/71	1935	Initial Checkout in Bldg. 33, with no outer housing or top plate	Room	Room	Room
9/27/71	0045	EPS sitting on table outside test chamber	Room	Room	Room
9/27/71	1815	Test Case #2		-17°F	0°C
9/28/71	0825	End of Test Case #3		-52°F	-27°C
9/28/71	1835	End of Test Case #4		-70°F	-45°C
9/29/71	1140	End of Test Case #1		+5°F	+11.2°C
9/29/71	2300	Test Case #6 (not in thermal equilib)		92°F	+48.8°C
10/3/71	1300	After second Test Case #6	Room	Room	Room

FOLDOUT FRAME /

Data Processor Values

[illegible] pps Input = 2046 = Output = 2048; 2032										1 pps Input = 262,142 = Output = 260,096; 262,144										1/32 pps Input = 33,554,430 = Output = 0; 33,292,288									
				P6 ▼					P5 ▼																				
E1	E2	E3	E4	P5	P1	P2	P3	P4	P6	E1	E2	E3	E4	P5	P1	P2	P3	P4	P6	E1	E2	E3	E4	P5	P1	P2	P3	P4	P6
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	*	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
←													No Data Taken																→
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

* Worked OK w/16,777,216 T = -38.4°C

FOLDOUT FRAME 2

TEST REPORT: ELECTRON-PROTON SPECTROMETER ENGINEERING TEST UNIT, VIBRATION TEST

INTRODUCTION

On the 5th and 6th October 1971, the Electron-Proton Spectrometer Engineering Test Unit was subjected to the vibration testing called for in LEC document EPS-435, Verification Plan for Electron-Proton Spectrometer, Appendix 'A'.

PURPOSE

The purpose of the vibration test was to confirm the ability of the EPS structural design to withstand the specified vibration levels and to verify that the EPS electronics would survive these vibration levels and operate satisfactorily after being subjected to them.

DESCRIPTION

The EPS Engineering Test Unit consists of an electronics unit, of similar construction to that proposed for 'flight' units, mounted in a 'flight-type' electronics housing. This in turn is mounted via vibration isolators inside an outer structure. Figure 1 shows the general outline of the instrument, together with the instrument axes and Figure 2 shows the mounting arrangement in diagramatic form.

TEST DESCRIPTION

Prior to vibration testing, the EPS Engineering Test Unit received a thorough functional electrical checkout at the

LEC Radiation Instrumentation Department, to confirm that the electronics was operational and to provide a baseline for comparison after the test article had been vibrated in each axis.

On the 5th October 1971, the EPS Engineering Test Unit was taken to the NASA Vibration and Acoustic Test Facility, Building 45 at the Manned Spacecraft Center. The test article was instrumented on the isolation mounting brackets to provide data on the vibration input to the electronics package and then mounted to the test fixture as shown in Figure 3.

The Engineering Test Unit was then subjected to the 'R' axis sinusoidal and random vibration levels as defined in Appendix 'A'. It was then removed from the test fixture and returned to the LEC Radiation Instrumentation Department for a functional electrical checkout. Upon completion of the electrical checkout, the test article was returned to Building 49, mounted on the test fixture and subjected to the 'X' axis sinusoidal and random vibration levels of Appendix 'A'. It was then removed from the test fixture and again returned to LEC's Radiation Instrumentation Department for functional electrical checkout.

On the morning of 6th October 1971, the test article was again taken to Building 49 and placed upon the test fixture. It was then exposed to the sinusoidal and random vibration levels for the 'T' axis defined in Appendix 'A'. Upon completion of this vibration, the Engineering Test Unit was removed from the test fixture and returned to LEC for functional electrical checkout. This completed the vibration testing of the Engineering Test Unit.

TEST RESULTS

The results of the functional electrical checkouts are given in Appendix 'B'. The random vibration test inputs and electronic package responses are shown in Figures 4 to 9 inclusive. When the test article was disassembled, no loose screws or components were found, nor was there any other indication of mechanical failure.

CONCLUSION

The test results show that the EPS Engineering Test Unit completed vibration testing with no electrical failure or anomaly attributal to vibration and without any mechanical failure.

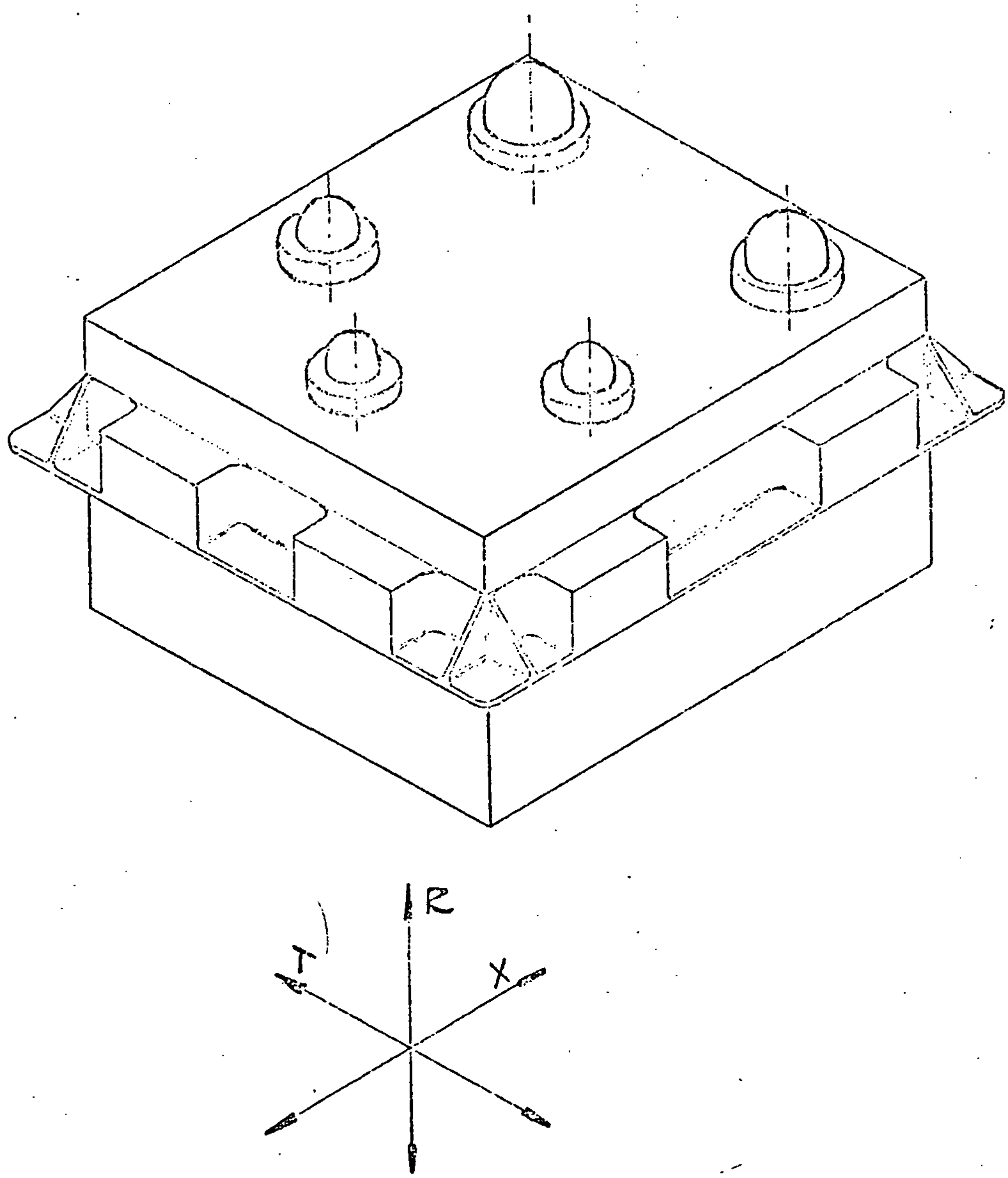


FIG. 1 — INSTRUMENT AXES.

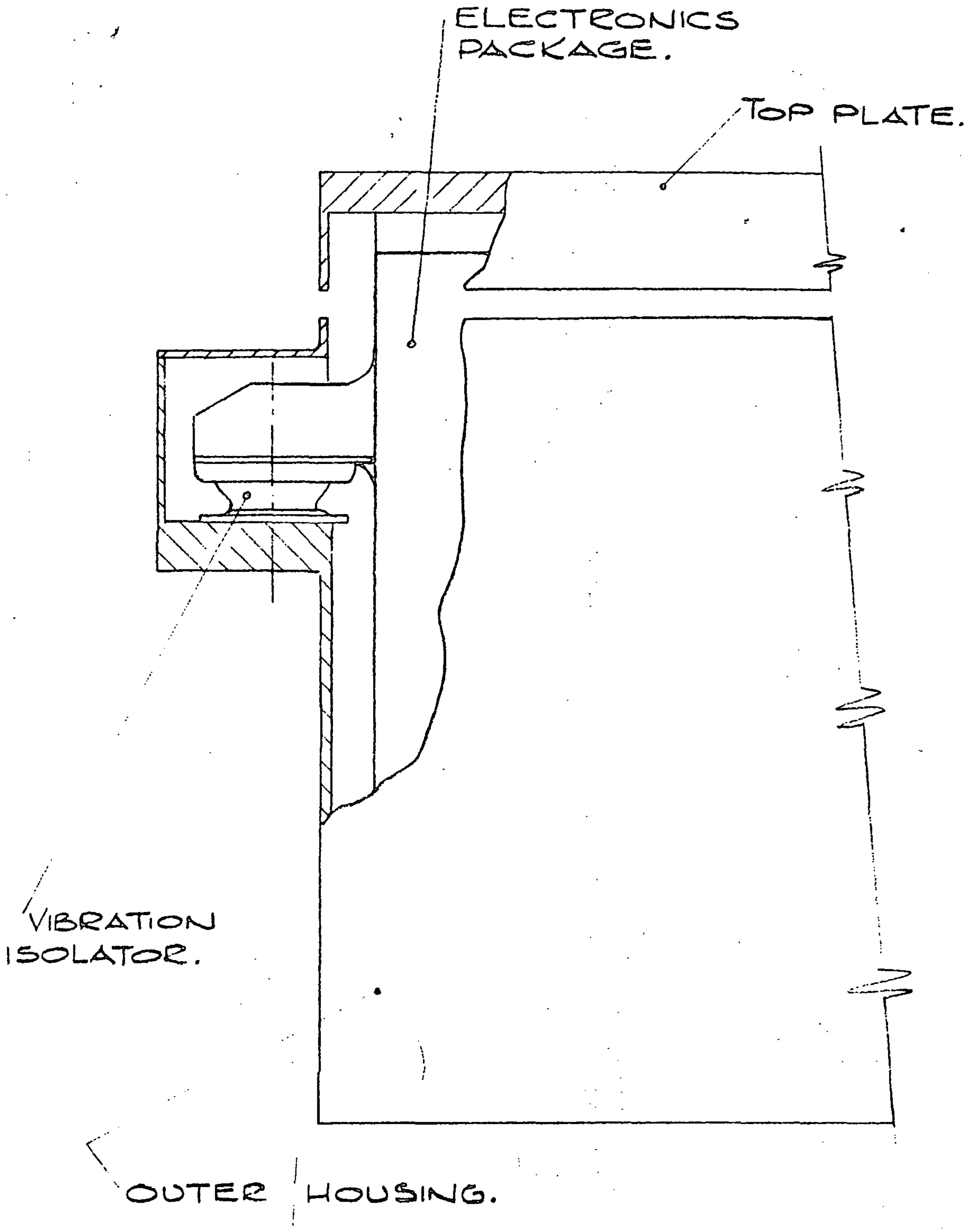


FIG. 2 - PACKAGE MOUNTING.

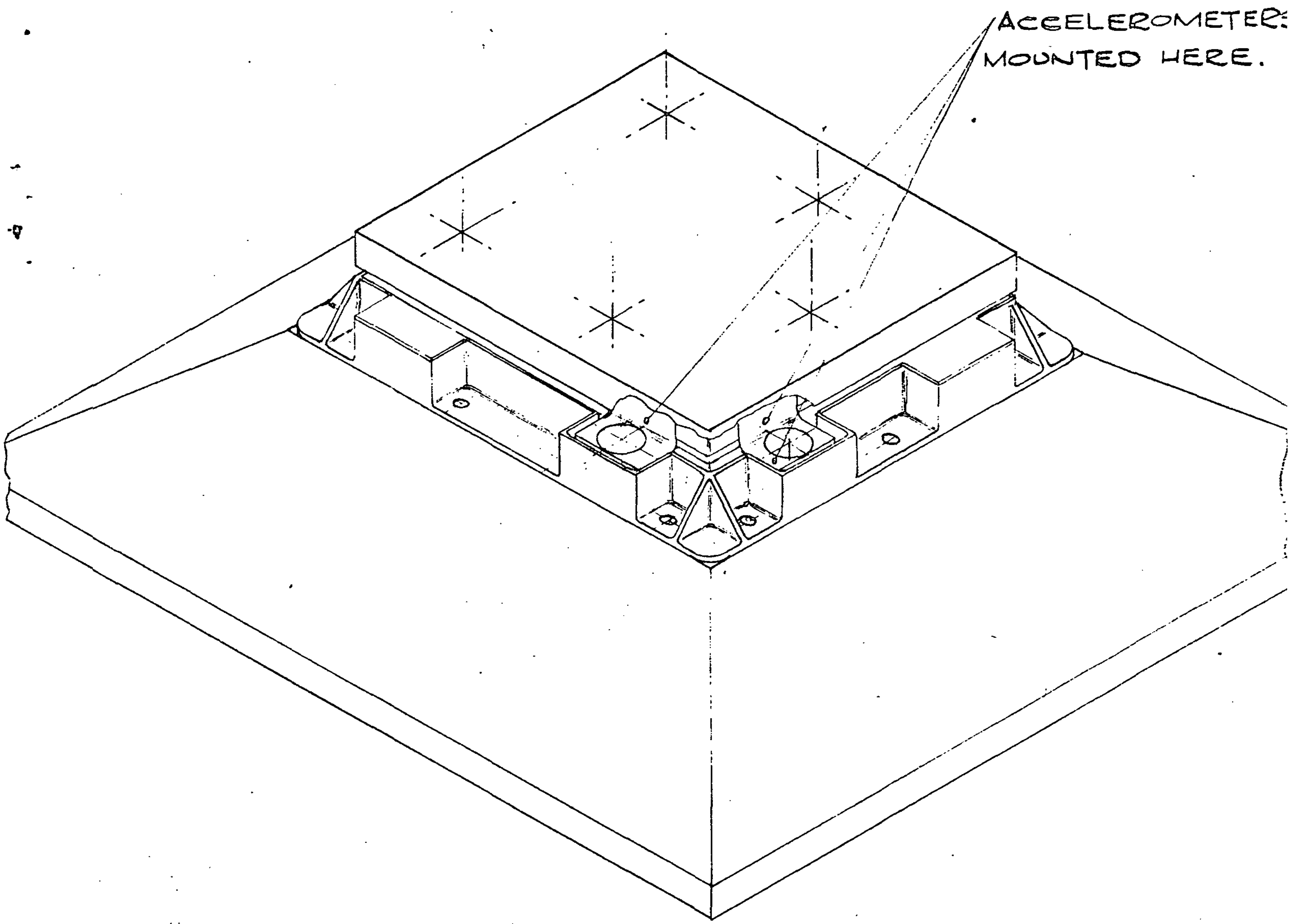


FIG. 3 EPS MOUNTED TO VIBRATION FIXTURE.

SENSOR CONTROL RUN EPS018 CAL=100. | TIME SLICE .000 TO 6.000
LOW-PASS FILTER..... 4000.0 | STANDARD DEVIATION.. 58.5242 | DATE PROCESSED...... 10/11/71
NORM STD ERROR...... .18204 | PLOT 0 SECS.= 11 24 55. DAY 278 | TAPE NUMBER.........
FILTER BANDWIDTHS... 5.0294
FILTER START POINTS. .0000

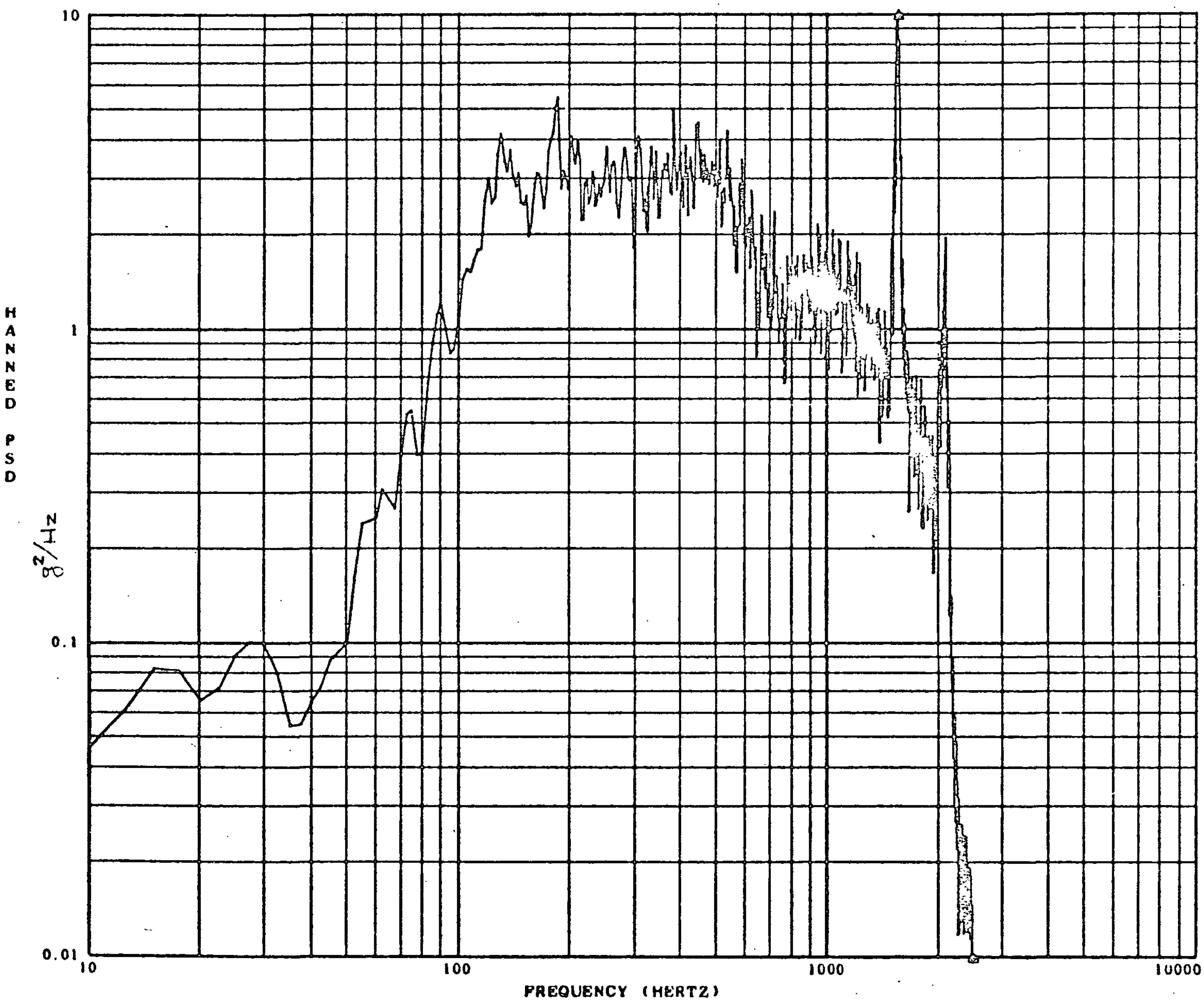


FIG. 4. 'R' AXIS, INPUT SPECTRUM
(HIGH ENERGY BURST) - 58.52 g rms.

SENSOR ACCELEROMETER 2 RUN EPS018 CAL=31.6 TIME SLICE .000 TO 6.000
LOW-PASS FILTER..... 4000.0 STANDARD DEVIATION.. 6.0860 DATE PROCESSED...... 10/11/71
NORM STD ERROR...... .18204 PLOT 0 SECS.= 11 24 55. DAY 278 TAPE NUMBER.........
FILTER BANDWIDTHS... 5.0294
FILTER START POINTS. .0000

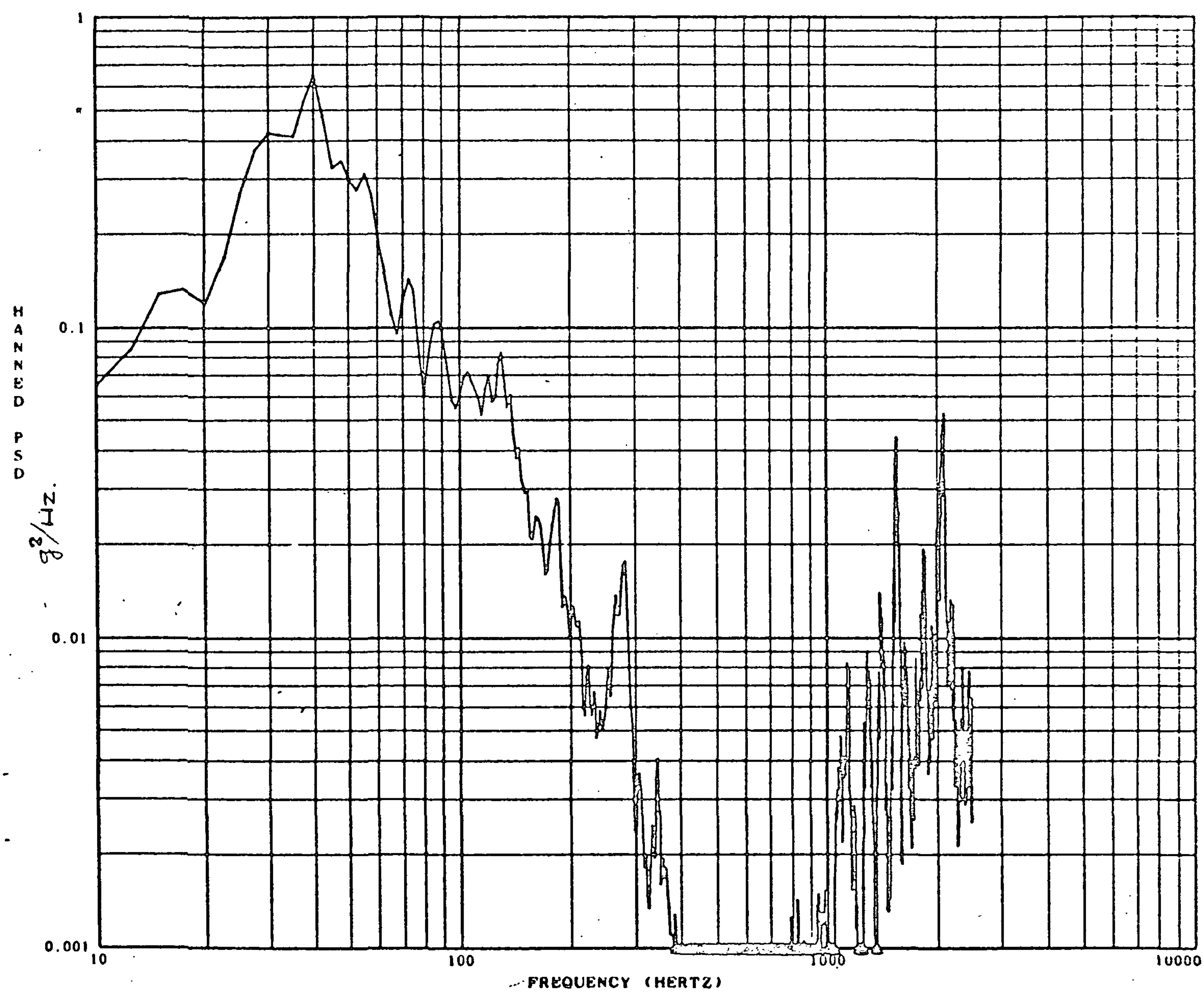


FIG.5 'R' AXIS, ELECTRONICS PACKAGE
RESPONSE - 6.09 g.r.m.s.

SENSOR CONTROL RUN EPS020 CAL=100. TIME SLICE .000 TO 6.000
LOW-PASS FILTER..... 4000.0 STANDARD DEVIATION.. 31.5209 DATE PROCESSED..... 10/11/71
NORM STD ERROR...... .1*203 PLOT 0 SECS.= 17 39 15. DAY 278 TAPE NUMBER ....
FILTER BANDWIDTHS... 5.0297
FILTER START POINTS. .0000

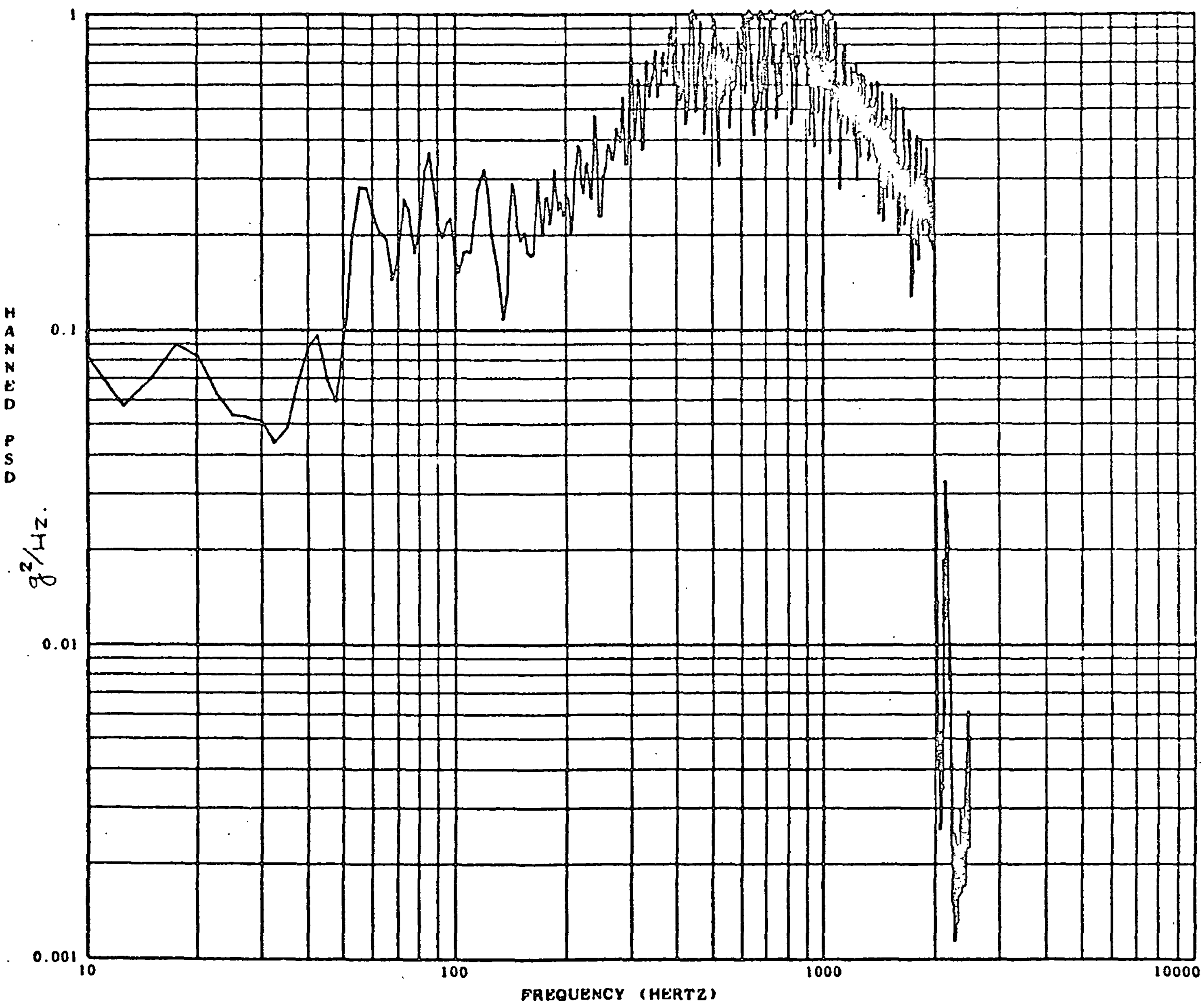


FIG. 6 'X' AXIS, INPUT SPECTRUM
(HIGH ENERGY BURST) - 31.52 g r.m.s.

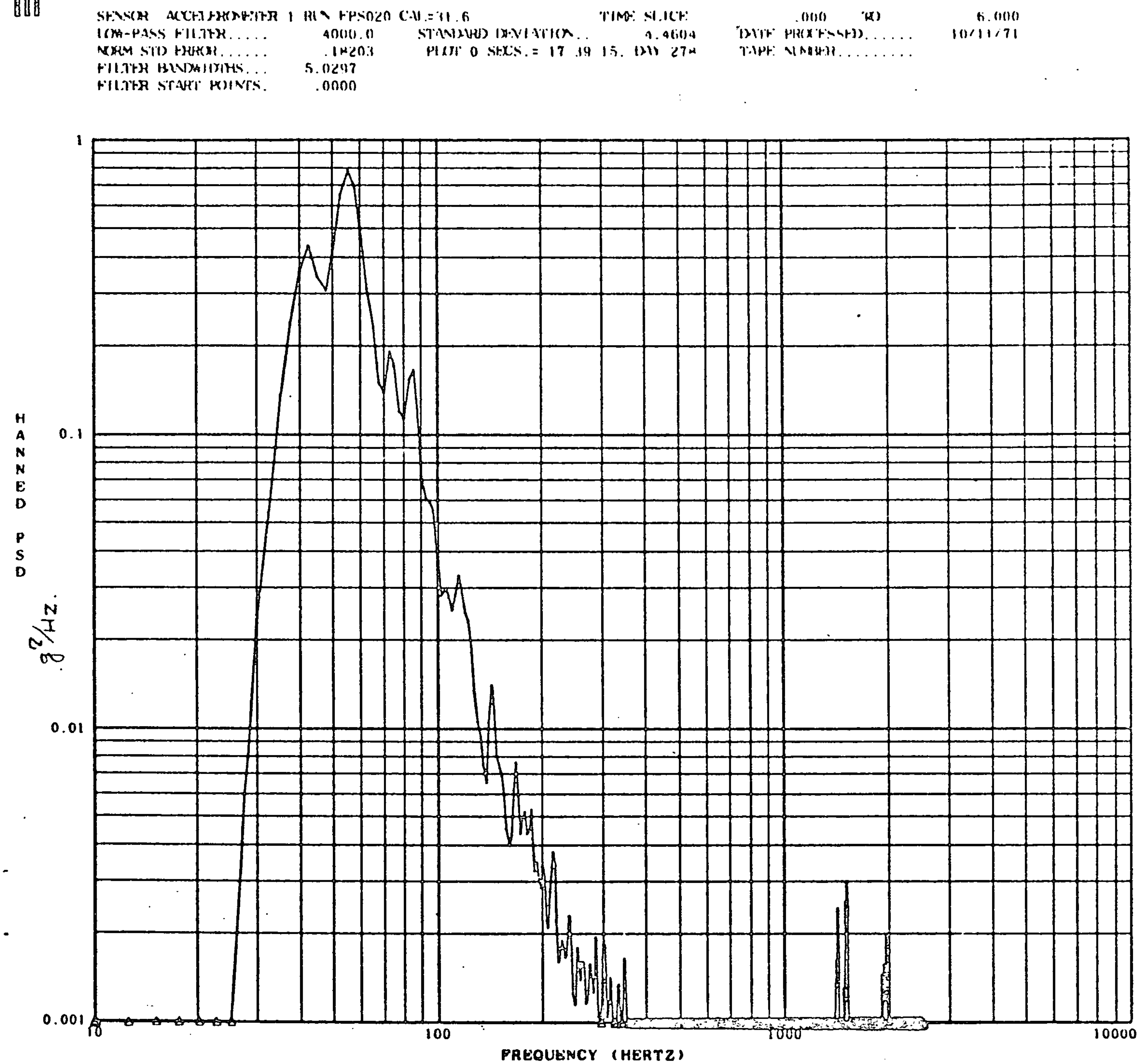


FIG. 7 'X' AXIS, ELECTRONICS PACKAGE RESPONSE - 4.46 g.r.m.s.

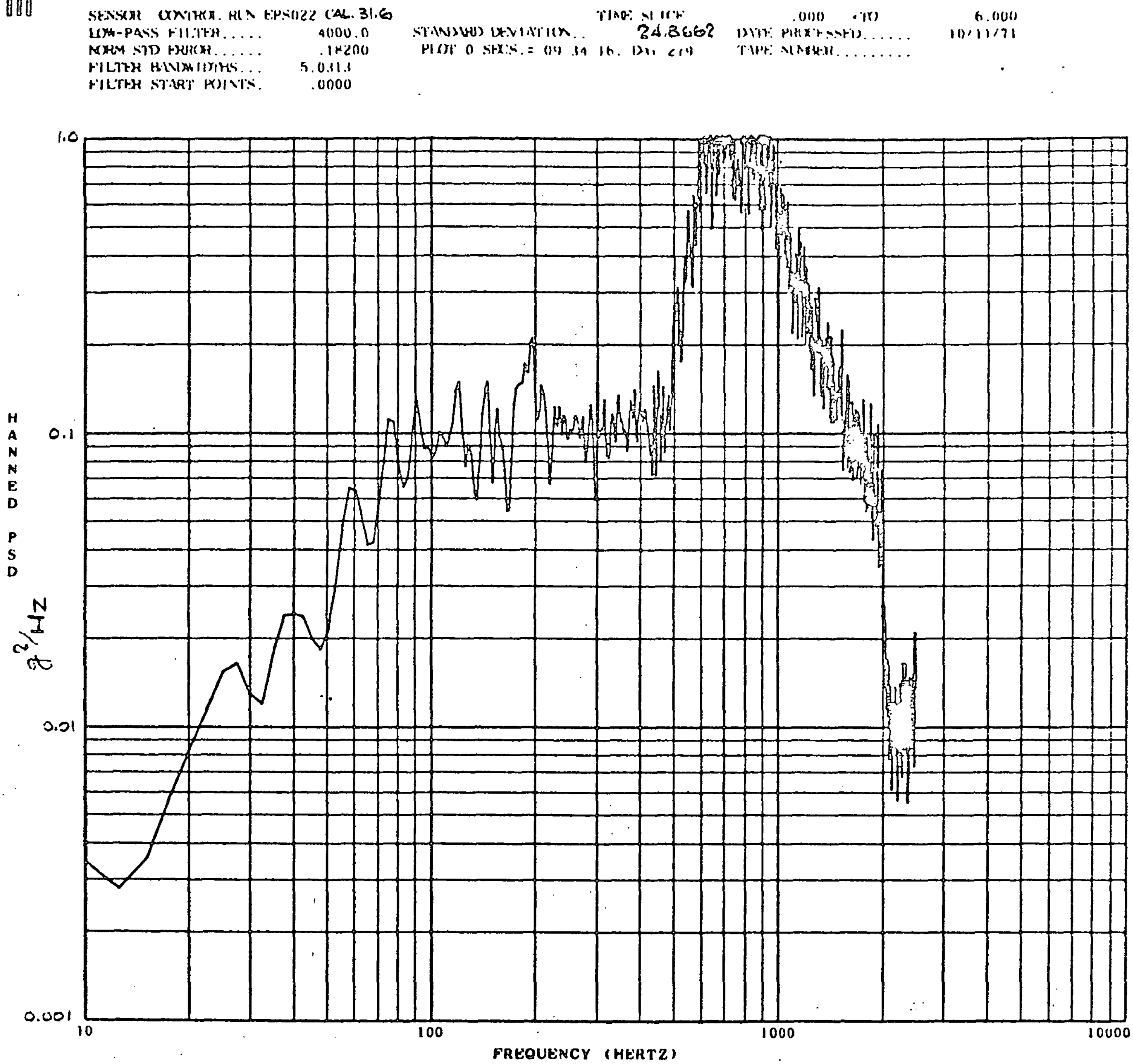


FIG. 8 'T' AXIS, INPUT SPECTRUM (HIGH ENERGY BURST) - 24.87 g r.m.s.

SENSOR ACCELEROMETER 3 RUN FPS022 CAL=31.6 TIME SLICE .000 TO 6.000
LOW-PASS FILTER..... 4000.0 STANDARD DEVIATION.. 3.5e1 DATE PROCESSED...... 10/11/71
NORM STD ERROR...... .18200 PLOT 0 SECS.= 09 34 16. DAY 279 TAPE NUMBER.........
FILTER BANDWIDTHS... 5.0313
FILTER START POINTS. .0000

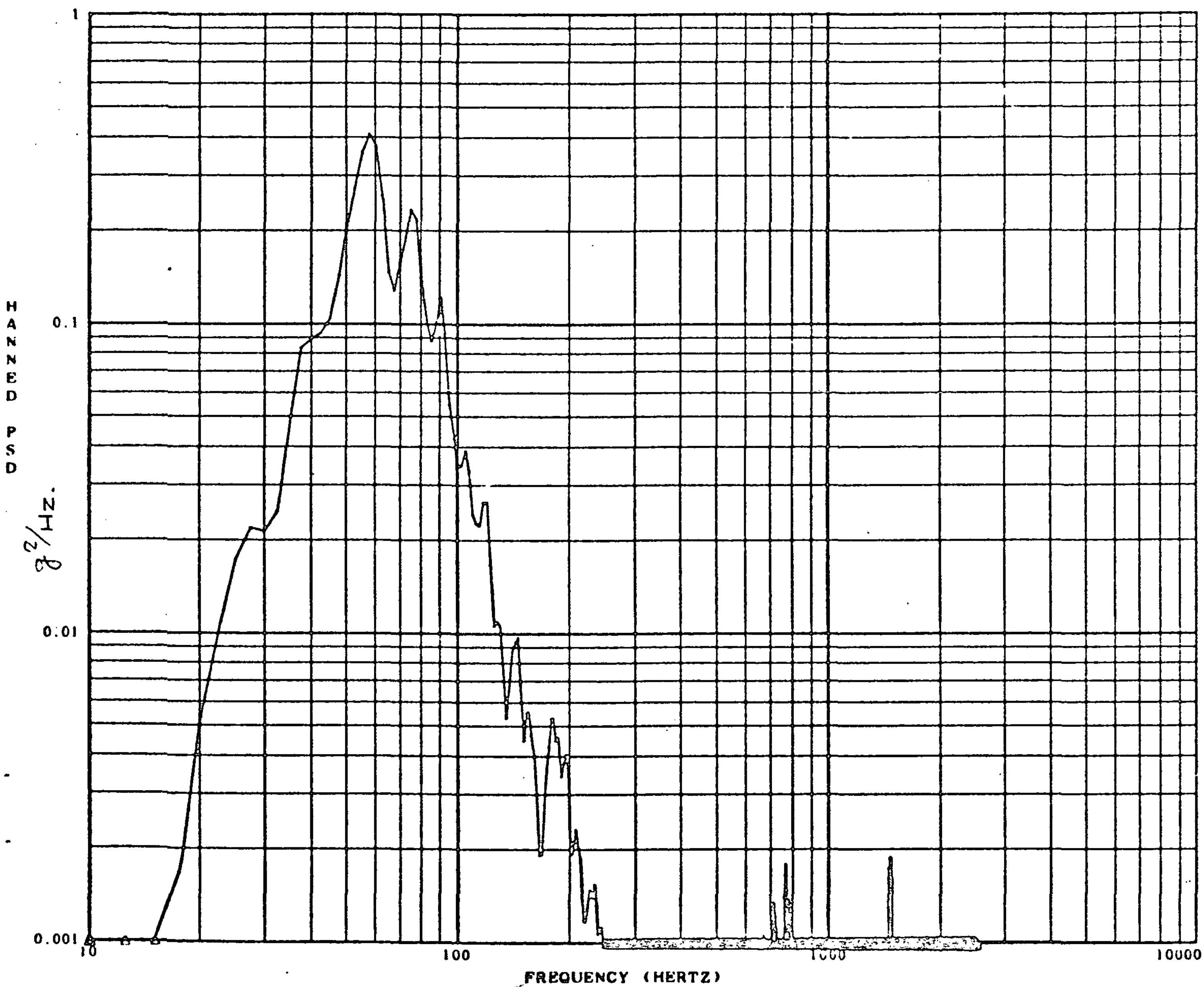


FIG. 3 'T' AXIS, ELECTRONICS PACKAGE RESPONSE – 3.58 g r.m.s.

APPENDIX 'A'

VIBRATION CRITERIA

Random:-

<u>R-Axis</u>

20 to 125 Hz	+12 dB/oct increase
125 to 500 Hz	2.0 g^2/Hz
500 to 670 Hz	-9 dB/oct decrease
670 to 1100 Hz	0.8 g^2/Hz
1100 to 2000 Hz	-9 dB/oct decrease

<u>X-Axis</u>

20 to 75 Hz	+6 dB/oct increase
75 to 175 Hz	0.085 g^2/Hz
175 to 300 Hz	+6 dB/oct increase
300 to 1000 Hz	0.25 g^2/Hz
100 to 2000 Hz	-6 dB/oct decrease

<u>T-Axis</u>

20 to 100 Hz	+6 dB/oct increase
100 to 440 Hz	0.04 g^2/Hz
440 to 600 Hz	+18 dB/oct increase
600 to 900 Hz	0.3 g^2/Hz
900 to 2000 Hz	-12 dB/oct decrease

For each of the above axes, duration is 140 seconds plus 10 seconds at 4 dB above the nominal.

Sinusoidal:-

Each Axis - Sweep from 5 to 35 to 5 Hz at .25 g peak.
Sweep Rate - 3 octaves/min.

Appendix B
Functional Test Results

Date	Time of Day	Test Conditions	Disc. Ref.	Outside Temp	Det Temp	Package Temp
10/5/71	0720	Base Line for Vibration		Room		+37°C
10/5/71		After R-axis Vibration	2.502			35.7
10/6/71	0807	After X-axis Vibration **	2.502			36.5°C
10/6/71	1435	After T-axis Vibration	2.502			38.1°C
10/6/71	1745	Rechecked E4 and P4				38.9°C
10/7/71	0755	Pre-shock	2.502			35.5°C
10/7/71	1503	Post shock	2.502			36.5°C

**Bias on

Date	Time of Day	Test Conditions	Outside Temp	Plate Temp	Package Temp
10/5/71	0630	Base Line for Vibration	Room		+37°C
10/5/71	1425	After R-axis Vibration			+34.8°C
10/6/71	0835	After X-axis Vibration			+36.7°C
10/6/71	1415	After T-axis Vibration			+38.0°C
10-7-71	1635	Post Shock			37.8°C

Date	Time of Day	Test Conditions	Outside Temp	Det Temp	Package Temp
10/5/71	0630	Base Line for Vibration	Room		37°C
10/5/71	1425	After R-axis Vibration			34°C
10/6/71	0845	After X-axis Vibration			36.7°C
10/6/71	1345	After T-axis Vibration			37.7°C
10/7/71	1635	Post Shock			37.8°C

FOLDOUT FRAME /

Discriminator Values

P.D. 2005 Output Required for 50% Counting

E1x10	P1	E2x10	P2	E3x10	P3	E4x10	P4	P5 (BTE calls P6)	P6 (BTE calls P5)
-1.4460	-3.6966	-1.3720	-4.3560	-1.3450	-4.2272	-1.2700	-2.3335	-6.7100	-2.5194
1.4460	3.703	-1.3730	-4.3691	-1.3515	-4.256	-1.2760	2.334	-6.740	-2.5294
-1.4460	-3.6974	-1.3720	-4.3541	-1.3450	-4.2280	-1.2740	-2.3407	-6.7130	-2.5187
1.4470	-3.7001	-1.371	-4.3538	-1.3446	4.2278	-1.3000	-2.3900	-6.7010	-2.5144
						-1.283	-2.3346		
-1.4470	-3.6476	-1.3680	-4.3540	-1.3450	-4.2423	-1.275	-2.3169	-6.7140	2.5205
-1.4470	-3.7020	-1.3710	-4.3589	-1.3450	-4.2312	-1.2760	-2.3223	-6.7223	2.5222

ADC Values

Housekeeping +350 V Monitor

P.D. Output							
0.025	0.050	0.100	1.000	2.000	3.000	4.000	4.900
0.034	0.059	0.108	1.007	2.009	3.011	4.013	4.917
0.039	0.059	0.112	1.012	2.014	3.016	4.018	4.917
0.034	0.059	0.108	1.012	2.014	3.016	4.018	4.917
0.034	0.059	0.108	1.012	2.014	3.016	4.018	4.917
0.034	0.059	0.108	1.007	2.009	3.011	4.013	4.912

Leakage Current Tests

P.D. = +30.000 Vdc					P.D. = 40.000 Vdc				
A	B	C	D	E	A	B	C	D	E
3.377	3.387	1.461	3.377	1.466	4.516	4.531	1.955	4.516	1.960
3.377	3.387	1.461	3.377	1.466	4.516	4.531	1.955	4.516	1.960
3.377	3.387	1.461	3.377	1.466	4.516	4.531	1.955	4.516	1.960
3.377	3.387	1.461	3.377	1.466	4.516	4.531	1.955	4.516	1.960
3.377	3.387	1.461	3.377	1.466	4.516	4.531	1.955	4.516	1.960

FOLDOUT FRAME 2

Fe

Date	Time of Day	Test Conditions	Det Temp	Package Temp	[illegible] Rate	A
10/5/71	0630	Base Line for Vibration		37°C	Disconnected	.978
				37°C		.973
10/5/71	1205	After R-axis Vibration				
10/6/71	0845	After X-axis Vibration		36.7		.972
10/6/71	0845	After X-axis Vibration (second reading)		36.7		.972
10/6/71	1401	After T-axis Vibration		37.9°C		.992
10/6/71	1401	After T-axis Vibration (second reading		37.9°C		.99[illegible]
10/7/71	1645	Post Shock		37.8°C		.992
10/7/71	1645	Post Shock (second reading)		37.8°C		.99[illegible]

B-2

Date	Time of Day	Test Conditions	Outside Temp	Det Temp	Package Temp
10/5/71	1205	After R-axis Vibration	Room		26°C
		After X-axis Vibration			
10/6/71	1535	After T-axis Vibration	80°F		38.6°C
10/7/71	1530	Post Shock			37.0°C

FOLDOUT FRAME 1

Resolution Monitor Values

A	B	C	D	E	BNC Rate	A	B	C	D	E
.978	1.383	1.002	1.188	1.149	7.049	3.319	4.150	2.023	3.060	1.843
.978	1.388	1.002	1.183	1.149	7.051	3.319	4.154	2.019	3.069	1.843
No Data Taken after R-axis Vibration										
.9726	1.398	.997	1.301	1.158	7.052	3.309	4.149	2.038	3.358	1.848
.9726	1.388	.997	1.300	1.158	7.052	3.314	4.164	2.014	3.416	1.843
.992	1.413	1.022	1.310	1.183	7.0441	3.309	4.125	2.033	3.495	1.857
.992	1.413	1.022	1.305	1.178	7.0441	3.309	4.145	2.028	3.489	1.857
.992	1.437	1.031	1.505	1.188	7.0433	3.314	4.145	2.038	3.490	1.872
.997	1.427	1.031	1.544	1.193	7.0433	3.314	4.150	2.033	3.553	1.872

Data Processor Values

1 pps Input = 2046 = Output = 2048; 2032									
E1	E2	E3	E4	P5 (P6)	P1	P2	P3	P4	P6 (P5)
X	X	X	X	X	X	X	X	X	X
No Data Taken after X-axis Vibration									
X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X

1 pps Input = 262,142 = Output = 260,096; 262,144									
E1	E2	E3	E4	P5	P1	P2	P3	P4	P6
X	X	X	X	X	X	X	X	X	X
No Data Taken after X-axis Vibration									
X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X

1/32 pps Input = 33,554,430 = Output = 0; 33,292,288									
E1	E2	E3	E4	P5	P1	P2	P3	P4	P6
X	X	X	X	X	X	X	X	X	X
No Data Taken after X-axis Vibration									
X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X

FOLDOUT FRAME 2

TEST REPORT: ELECTRON-PROTON SPECTROMETER
ENGINEERING TEST UNIT, SHOCK TEST

TEST REPORT: ELECTRON-PROTON SPECTROMETER ENGINEERING TEST UNIT, SHOCK TEST

INTRODUCTION

On Thursday, 7 October 1971 the Engineering Test Unit of the Electron-Proton Spectrometer (EPS) was taken to Building 15, NASA Manned Spacecraft Center to be subjected to the Shock Test requirements of MIL-STD-810B, Method 516.1, Procedure 1 as called for in LEC document number EPS-435, Verification Plan for Electron-Proton Spectrometer, Appendix E.

PURPOSE

The purpose of the Shock Test was to verify both the ability of the EPS design to withstand the required shock level and the electronics to operate satisfactorily after being subjected to the shock requirements.

DESCRIPTION

The EPS Engineering Test Unit consists of an electronics unit, of similar construction to that proposed for 'flight' units, mounted in a 'flight-type' electronics housing. This in turn is mounted via vibration isolators inside an outer housing. Figure 1 shows the mounting arrangement in diagramatic form.

TEST DESCRIPTION

Prior to shock testing, the EPS Engineering Test Unit was subjected to a thorough functional electrical checkout at the LEC Radiation Instrumentation Department to provide a baseline for comparison after completion of the shock testing.

The test article was then taken to Building 15, NASA/MSC. Configuration of the instrument was as shown in Figure 2, which also references the test axes of the instrument.

The instrument was mounted in a simple box fixture, in exactly the same manner as it would be mounted for use, and set up in the drop test machine to drop in the -X axis. Figure 3 shows a generalized view of the mounting.

The test article was then subjected to 3 drops in this axis. On completion, the unit was realigned to the +X axis, and the 3 drops were repeated. This sequence was repeated until the instrument had been dropped three times in both directions on each of its three mutually perpendicular axes - a total of 18 drops, thus completing this phase of the shock test.

The Engineering Test Unit was then returned to the LEC Radiation Instrumentation Department, where it was again submitted to the functional electrical checkout, and the data obtained compared to the baseline data established prior to the shock testing.

TEST RESULTS

The shock response of the electronics package was not monitored during this test. Figure 4a shows the specified shock pulse and Figure 4b shows typically the shock pulse achieved. Figure 4c shows the drop test pulse in the -R direction that deviated considerably from the norm. Figure 5 gives the shock input levels and duration for each test drop.

Appendix A gives the results of the functional electronic checkouts.

CONCLUSIONS

Examination of the test results show that the EPS Engineering Test Unit operated satisfactorily after completion of the shock testing, and it is concluded that the test article met and passed the test purpose and requirements.

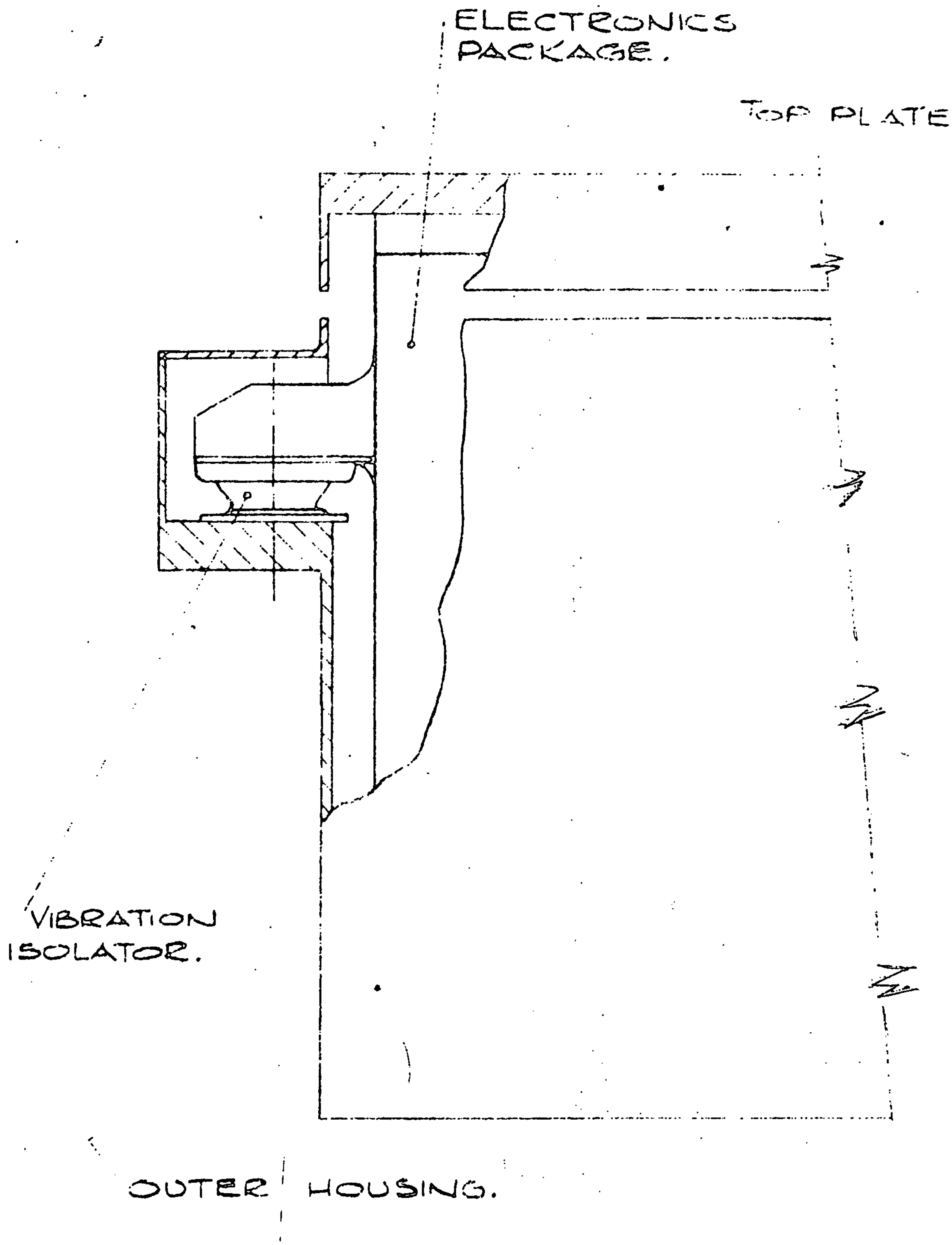


FIG. 1 – PACKAGE MOUNTING.

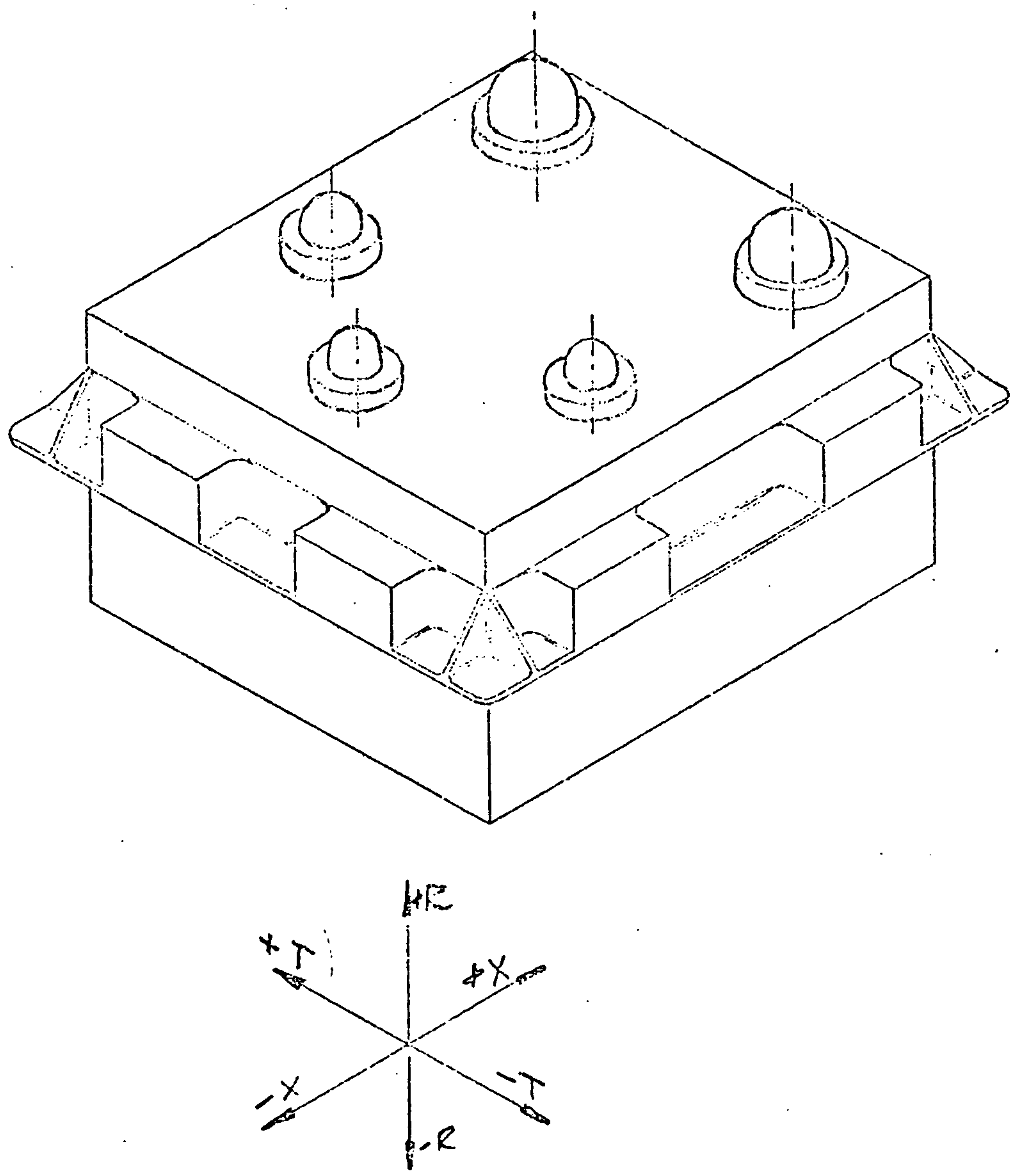


FIG. 2 — INSTRUMENT AXES.

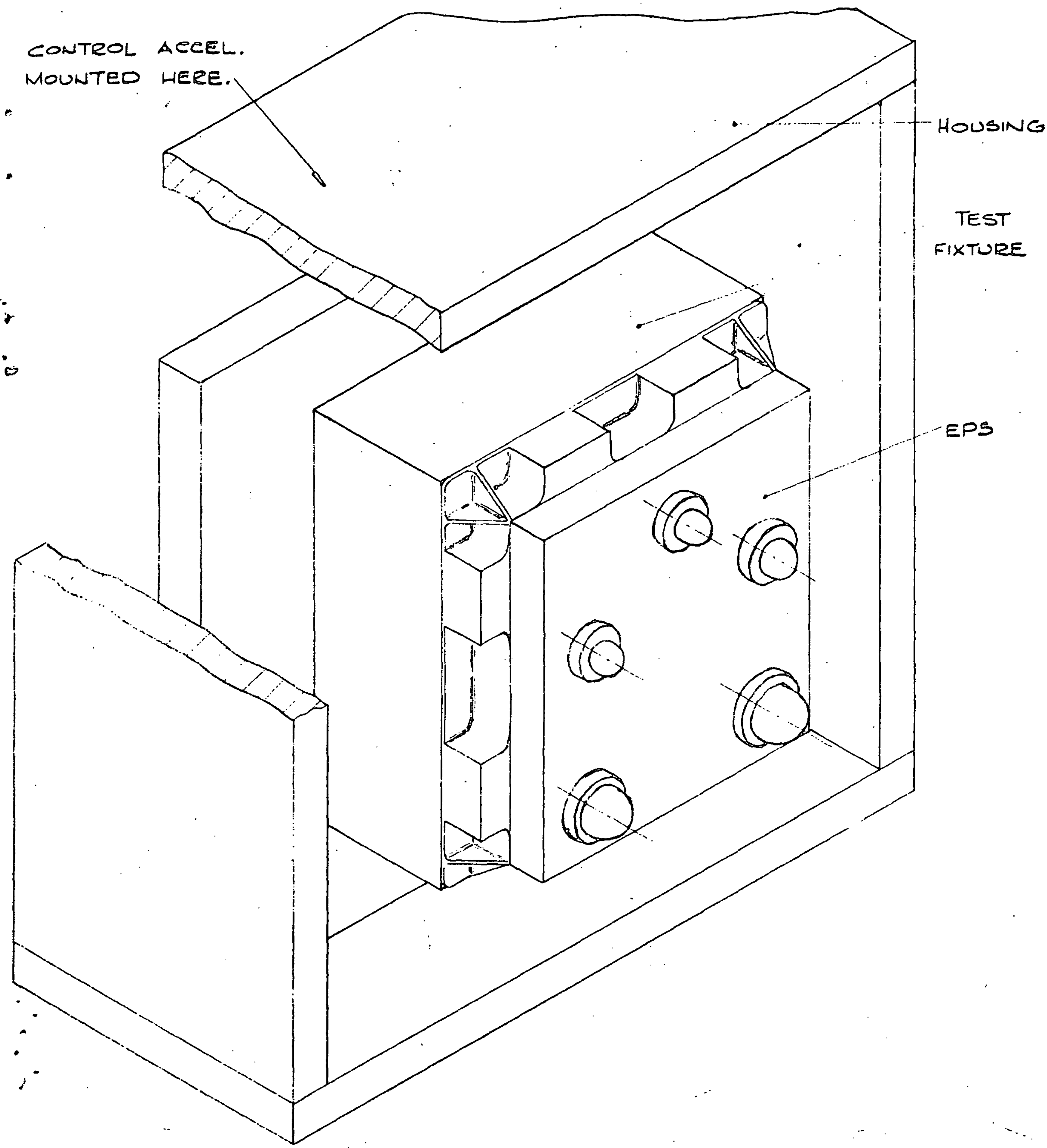
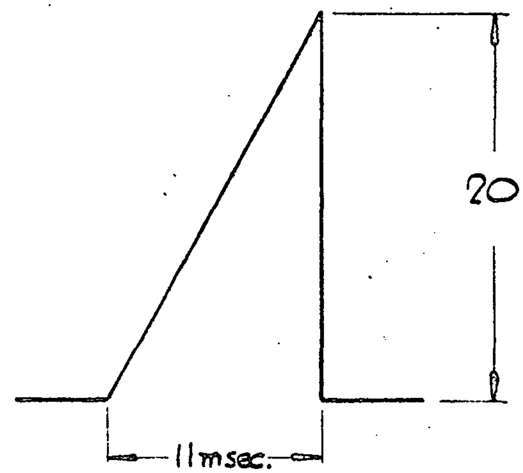
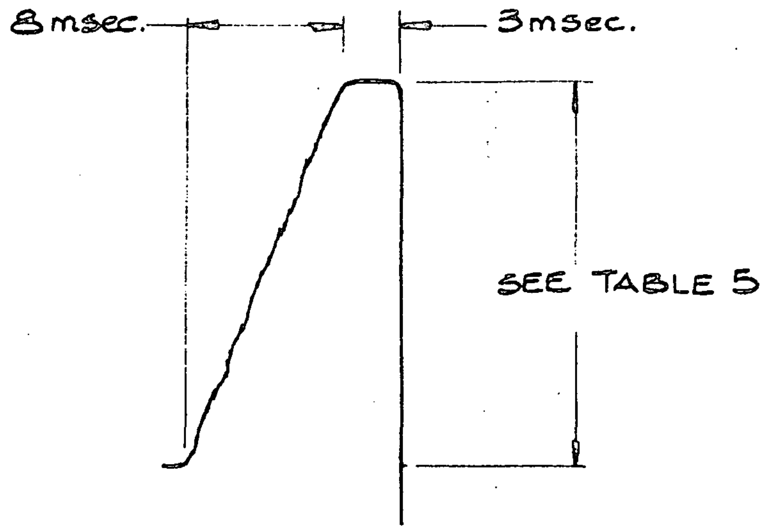


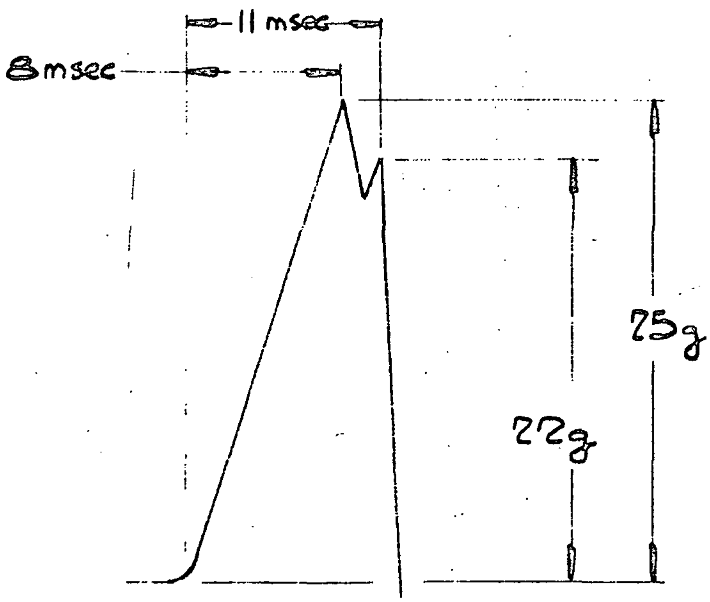
FIG. 3 — MOUNTING OF EPS
— SHOCK TEST.



(a) TEST SHOCK PULSE.



(b) ACTUAL SHOCK PULSE
(TYPICAL)



(C) ABNORMAL SHOCK PULSE – 'R' AXIS

FIG. 4

SHOCK TEST PULSE MAGNITUDE
AND DURATION

Axis and Direction		Magnitude (g)	Duration
	(1)	22	
-X	(2)	21	See Fig. 4b
	(3)	22	
	(1)	22	
+X	(2)	22	See Fig. 4b
	(3)	21	
	(1)	21	
-T	(2)	22	See Fig. 4b
	(3)	21	
	(1)	21	
+T	(2)	21	See Fig. 4b
	(3)	22	
	(1)	21	See Fig. 4b
-R	(2)	22	See Fig. 4b
	(3)	25 (See Fig. 4c)	See Fig. 4c
	(1)	21	
+R	(2)	21	See Fig. 4b
	(3)	22	

Figure 5

Appendix A
Functional Test Results

See Appendix B of Vibration Test (second report) in this compilation.